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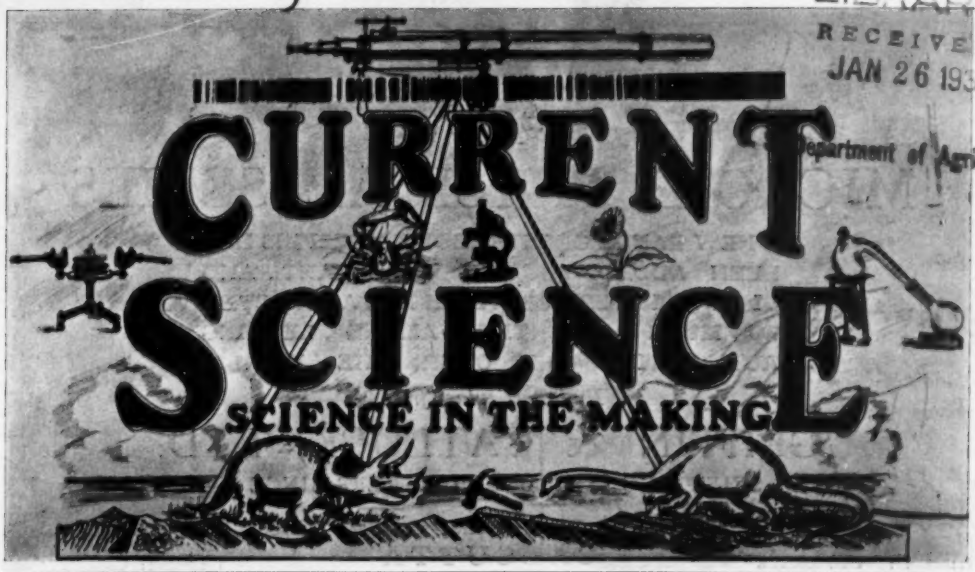


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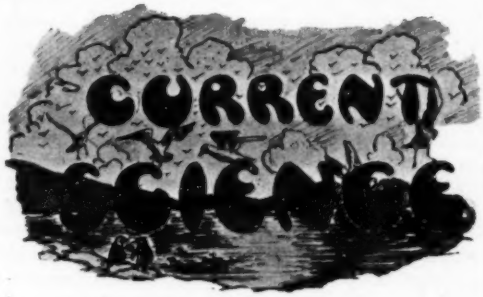


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CONTENTS.





## The Problem of the Molasses.

THE discussions at the last Sugar Conference held at Simla (*Curr. Sci.*, **2**, 58, 1933) and the more recent meeting of the Sugar Committee at Coimbatore (*Curr. Sci.*, **2**, 202, 1933) have borne ample testimony to the fact that the provincial Governments as also the promoters of the sugar industry are quite alive to the seriousness of the new problem which they are faced with. With the creation of a number of new factories and the increased output of white sugar, the problem of the molasses has already assumed such serious proportions that it can no longer be ignored. In fact, we may even go further and state that when the protective tariff is withdrawn and the internal as well as external competition increases with the inevitable fall in prices, the intelligent utilisation of the hitherto neglected by-product may make all the difference between success and failure in the industry.

Not many years ago, India was importing quite considerable quantities of cane molasses, chiefly from Java. The imports have now very nearly disappeared and the home production so considerably increased that several factories have already got large stocks which they could not adequately dispose of. The present (1932–33) production may be reckoned at 450,000 tons and even a conservative estimate—based on the possible output of white sugar—would suggest that the manufacturers would be faced with the problem of dealing with no less than 500,000 tons during 1933–34 and subsequent years.

The problem of the molasses is not, however, unique to India. It is an inevitable consequence of the development of the white sugar industry and all the big sugar-producing countries like Java, Cuba, Natal, Hawaii, Mauritius, Queensland and Germany have had to face it. Various methods of utilising molasses (from cane or sugar beet) have been proposed and although none of them has proved wholly satisfactory, there is yet some evidence to suggest that at least some of them hold out promise of extended application. An attempt will therefore be made to critically examine the various methods now in use and to suggest a few lines along which further enquiry could be profitably undertaken.

The composition of cane molasses varies considerably depending on the variety of cane, manuring, system of boiling the juice, method of hardening and storage of the molasses and such like. It may be reckoned, however, on an approximate basis, that an average specimen contains about 40 per cent. of cane sugar, 30 per cent. of invert sugar (as glucose), 15–20 per cent. of moisture and the rest in the form of nitrogen and minerals. The nitrogen content is generally low, being under 1·0 per cent. but some specimens have been reported to contain higher percentages. Among the mineral constituents, potash ($K_2O$) accounts for a large share, being 1·9–4·6 per cent., and phosphoric acid ($P_2O_5$) 0·16–0·54 per cent. It is generally reckoned that molasses contains about 50 per cent. of the nitrogen originally present in the cane and 60 per cent. of the potash. Cane molasses can stand a reasonable amount of storage, but prolonged keeping leads to loss of sucrose, slow, irregular increase in invert sugar and general increase in non-sugars (Browne, *Ind. Eng. Chem.*, **21**, 600, 1933). Recently, a patent has been taken for producing dry molasses by grinding the liquid product with alfalfa meal and spray-drying the mixture in a current of hot air (Amer. Pat. No. 1,897,732 of 1933), but further information regarding the cost of production and the keeping quality of the final product is needed before any opinion regarding the utility of the process can be expressed.

Among the various methods of utilising molasses those with the possibility of its consumption as food deserve the most careful consideration. It has been suggested that fancy sugar syrups can be prepared out of it, but with clean, white sugar plentifully available, it is very doubtful if there would be much demand for molasses. A similar criticism would also apply to the suggestion that it could be used for the manufacture of caramel. Anyway, the quantities consumed by such industries would be almost negligible as compared with the huge stocks of molasses that would tend to accumulate in the near future. The demand for use as animal feed would appear to fluctuate considerably, the sale of molasses bringing some useful return only when other feeds are scarce (Kerr, *Proc. 4th Congress Int. Soc. Sug. Tech.*, 1932).

The utilisation of beet molasses for the manufacture of yeast would appear to have received considerable attention in Germany. The yeast, thus prepared, is mostly taken up by the bread industry, but with the increasing knowledge of the high nutritive value of yeast, it is not unlikely that the product will soon find favour as an animal feed. Cane molasses is comparatively poor in nitrogen and buffers and tends to become more readily acid than the beet product, but this defect can be remedied by addition of suitable nitrogenous substances together with the necessary mineral salts. The yield of pressed (wet) yeast which, under favourable conditions, would be nearly as much as that of the original molasses would appear to be a useful return for the sugar and inorganic salts used up by the organisms.

In this connection it should be pointed out that the manufacture of yeast is a different process from that of fermentation to alcohol. In the former process, the yeast being the chief end product, the saccharine medium is enriched with nutrients and subjected to aeration so that practically no alcohol is formed. It is not necessary that typical fermentation yeasts (*Saccharomyces*) should be used for the manufacture: even pseudo-yeasts like *Mycoderma*, *Torulae* and *Sarcinae* which do not produce more than traces of alcohol, may be used for the purpose: in fact some of the latter would appear to be efficient than the fermenting yeast in converting a given weight of sugar into its body material. The use of pseudo-yeasts has a further advantage in that it requires no excise control. The final product is almost exclusively the mass of the living organism which is quite nutritious and eminently suitable for animal feed. It is even fit for human consumption and there is evidence to show that *Torulae* were used as human food during certain wars in France. The yeast can be consumed either in the wet condition or in the dry form. The drying is fairly easy and can be carried out either in the sun or in a current of hot air. The dried product which may be described as a form of concentrated food would contain nitrogen and the essential minerals in organic combination—a condition that is most desirable from the point of view of efficient assimilation—together with the related vitamins, and other valuable food accessories. The nutritive value of the final product would thus be very much greater than that of the original molasses, a fact which, if sufficiently known, would soon raise the yeast into a position of great favour with the farmers.

In recent years increasing evidence has also been obtained to show that yeasts and allied organisms contain certain ingredients which help to promote the growth of plants. More recently, it has also been observed that yeast extracts also help to increase the reproductive efficiency of plants (*Curr. Sci.*, **2**, 161, 1933). These and related observations would suggest that use of the dry yeast may soon find an important place in regular field practice.

From the above it would be seen that the manufacture of dry yeast (or an allied organism) from cane molasses is a promising line of enquiry which requires careful investigation.

Direct utilisation of molasses as fuel has been tried in a few countries, but the result does not appear to have been satisfactory. The product has low fuel value and added to that there is trouble with clinkering in boilers which is highly undesirable.

Among the various methods so far known, alcoholic fermentation for the manufacture of spirituous liquors and for the production of industrial alcohol would appear to be the most satisfactory way of utilising molasses. For various reasons, the consumption of molasses, by distilleries, has, so far, been only a small fraction of the total output, but it may be reasonably expected that, with more favourable conditions and improved methods of distilling for absolute alcohol, the major part of the molasses produced in the country would soon be taken up by that industry. In addition to its uses as a solvent and as an essential basic material for the manufacture of a variety of fine chemicals and pharmaceuticals, the utilisation of absolute alcohol, either by itself or in association with petrol (upto 30 per cent.) for internal combustion engines, deserves careful consideration. The merits and demerits of alcohol as a fuel have been indicated elsewhere in this issue (*Curr. Sci.*, **2**, 202, 1933). Suffice it, therefore, to point ont that if the difficulties associated with the illicit consumption of alcohol can be avoided; if the mixture of absolute alcohol and petrol can be moderately stabilised so that even if some moisture is absorbed, the two liquids will not separate; if the defects associated with incomplete combustion of alcohol can be eliminated; and if the problems connected with the transport and distribution of alcoholic petrol can be satisfactorily solved without imposing additional burden on the consumer, then the process of fermentation to alcohol will be one of the most satisfactory methods of utilising cane molasses.

A number of investigations have been carried out to study the possibility of utilising molasses in a number of minor fermentation industries such as those of lactic or citric acid, acetone and butyl alcohol or glycerin. Some of these studies have led to encouraging results, but the related processes are more difficult to control than that of alcoholic fermentation. The conditions of fermentation will therefore have to be carefully standardised if satisfactory yields of the desired products are to be obtained. The cost of manufacturing the different products should be compared with those by other known methods and the production adjusted to the limited demands of the market. The cost of manufacturing glycerin from molasses is stated to be less than that of recovery during soap manufacture but the estimates would require verification under the tropical conditions. The above and related subjects require further investigation.

A few years ago there appeared an announcement regarding the successful polymerisation of sucrose to yield a number of valuable solid and plastic materials (sakaloids). It was claimed by Ford, the inventor, that depending on the nature of the treatment, he could convert refined sugar or molasses into the following:—(1) A hard glassy substance which could be used as a glass substitute. The glassy material was claimed to be shatter-proof and to possess the advantage of being cut into the desired shape with a sharp knife: it was also found suitable for the manufacture of lenses and other useful articles. (2) A transparent substance with elastic properties and suitable for use as a substitute for rubber and leather. (3) A celluloid-like solid that could replace the inflammable celluloid. (4) A moulding powder that could be pressed to any desired shape in a hot press. A number of uses were contemplated for the new plastic materials both by themselves and in association with cellulose esters—artificial leather, wall hangings, adhesives, textiles, lenses, photographic films, transparent wrapping sheets, roofing tiles, paints and varnishes. It was claimed by the enthusiasts of the new process that 'the woman of the immediate future might look forward to being clothed from head to foot in spun sugar polymerised by the Ford

process, wearing shoes of sugar leather with heels of sugar plastic; write with a sugar pen from a sugar mounted bag, which contains an unbreakable sugar mirror, sit in a sugar plastic chair and watch a picture projected by a sugar lens through a sugar photographic film.' (Cited from *Int. Sug. Jour.*, **33**, 375, 1931.) Nothing has, however, since been heard of the process which started under such favourable auspices. It is not improbable that the cost of production which was reckoned to be 9½ cents. (5 As. at the present rate of exchange) per pound was found to be excessive as compared with casein and other plastic materials which could be obtained at cheaper rates. It would be of interest, however, to study the properties of sakaloid and such other sugar plastics with a view to determining whether they possess any rare properties which would entitle them to preferential use in some manufactures.

It has been stated that molasses can find application, in the foundry, as a substitute for core oils and core gums (*The Chem. Trade J.*, Nov. 9, 1928). A recent German patent (No. 537128) claims a method of manufacturing linoleum cement, a composition containing molasses, kaolin, copal and alcohol. These and similar uses deserve examination though it is hardly likely that any large quantities of molasses will thus be consumed.

In recent years a large amount of interest has centred round the utilisation of molasses as fertiliser. In some of the sugar-producing areas it was found difficult to dispose of all the molasses produced in the course of a season and since discharging the product into rivers tended to pollute the water and kill the fish, some experiments were carried out applying the molasses to land at the rate of 8—10 tons per acre. The result was unexpectedly favourable. Although the immediate effect of the application was to kill out the existing vegetation, the subsequent crops came out exceedingly well. In Queensland, the effect was most marked on soils which are naturally deficient in potash (*Int. Sug. Jour.*, **35**, 422, 1933). In Java, investigations have been in progress since 1911 mainly with a view to standardising the conditions for the application of molasses to land. As the result of these researches it may now be stated that application at the rate of about 1,600 gallons per acre, together with the irrigation water, is perhaps the cheapest method of application. The rice crop which follows benefits as the result of the treatment and increased yields averaging about 43 per cent. have been reported. The molasses can be applied either before or after trenching provided at least three weeks are allowed for the initial reaction to subside prior to transplanting. The application may also be made, after planting, either of diluted or undiluted molasses, on the ridges or in the trenches, in very diluted form (approx. 0·1 per cent.) with irrigation water, and of these, the first is preferable. Application of undiluted or slightly diluted molasses has nothing to recommend it. In general, the effect of application of molasses is marked in the case of the succeeding rice crop than in that of cane. In the latter case the fertilising value of the molasses would appear to be largely influenced by soil conditions and water supply (*Int. Sug. Jour.*, **34**, 416, 1932). In Hawaii, on the other hand, molasses would appear to have proved quite useful as a fertiliser for sugarcane. Marked increases both in the yield of cane and percentage of sugar have been reported. The molasses would also appear to have some useful residual effect rendering phosphoric acid and potash more available for subsequent crops. In addition to direct application to land, experiments would also appear to be in progress in Hawaii investigating the possibilities of preparing a solid, easily granulated and portable material by submitting molasses to a charring treatment with concentrated sulphuric acid followed by additions of raw rock phosphate, ammonium phosphate and other nutrients, which should produce a mixture having many advantages as compared with the original molasses. It is expected that treatment with sulphuric acid would not only render molasses easy to handle but that it would also increase the availability of added phosphates and potassic salts (*Int. Sug. Jour.*, **34**, 108, 1932). Another method that has been proposed by the Hawaii workers is to mix the molasses with begasse, filter press cake, furnace ash and other factory wastes and then apply the mixture to land. These proposals deserve careful consideration in connection with the disposal of surplus molasses.

The use of molasses as a fertiliser raises a fundamental question as to what it is that is mainly responsible for the fertilising action; how it is that the earlier vegetation are adversely affected while the subsequent crops benefit; why some time should lapse between the application of the molasses and the transplantation of the rice seedlings;

and how it exerts a residual action by increasing the availability of minerals though none of the molasses is left behind? After about twenty years of research, the Java workers have come to the conclusion that the fertilising action is mainly due to the sugars, the effect produced by equivalent amounts of minerals and nitrogen being very small as compared with that of the molasses as a whole. Study of the associated microflora has shown that fungi are prominent when molasses is applied in high concentration while yeasts and bacteria are in considerable evidence when the product is applied in a diluted form. The mechanism of the action of the different organisms has not yet been thoroughly understood, but judging from previous evidence relating to the decomposition of carbohydrates under similar conditions, it would appear that various organic acids are the initial products of the fermentation of molasses in the soil (*J. Agric. Sci.*, **19**, 627, 1929). The sugar as well as the free acids are, as such, toxic to the living plant, but, after a time, the sugar disappears and the acids react with the soil minerals rendering them more soluble. The buffer action of the soil helps to adjust the reaction. As the result of a succession of such changes the land becomes suitable for transplantation of crop after about three or four weeks. More mineral food being thus available, the plants make better growth and increased yields are obtained. Although the above would help to explain some of the hitherto obscure aspects of the problem, further research directed towards the elucidation of the biochemical mechanism of the decomposition of molasses during 'wet' and 'dry' cultivation is greatly needed. If the biological transformations can be properly controlled so as to avoid undue loss of carbon in the gaseous form or profuse leaching out of soluble minerals; if the field practice can be so standardised that the application of molasses can be carried out without any special equipment or technical advice; if increased yields corresponding to those reported from Java can be consistently obtained under Indian conditions, then the utilisation of molasses as a fertiliser would deserve extended adoption, even in preference to use in fermentation and other industries.

It would be hardly possible to do justice to all the aspects of the problem in the course of a brief review as the present one is intended to be. It is hoped, however, that the discussion would create some interest in the subject as a whole and that the promoters of the industry and scientific workers in the country will actively co-operate in organising and carrying out an intensive programme of research which would soon help to throw light on different hitherto obscure aspects of the problem. It may further be hoped that, as the result of such efforts, the conditions for the most profitable method of utilising molasses will be standardised and that the troublesome by-product of the present moment will soon become an important source of revenue to the sugar industry.

## Asiatic Society of Bengal.

ON the 15th of January 1934, the Asiatic Society of Bengal, which was founded under the name of the *Asiatick Society*, on the 15th January 1784, by Sir William Jones, will reach the age of 150 years since its foundation The Society was founded to inquire into the history, civil and natural, the antiquities, laws, arts, sciences and literature of Asia, and during its long existence its usefulness has spread far and wide and it has to its credit a wonderful record of achievements.

The President and Council of the Society have decided to celebrate, on the 15th of January 1934, the 150th Anniversary of this foundation. The Anniversary programme will consist of a Conversazione in the Indian Museum, and a Banquet in the hall of the Society, followed by a special Anniversary Meeting to receive addresses from learned societies and to elect a number of Honorary Anniversary Members of the Society.

In connection with the centenary celebration in 1884 a volume depicting the progress of Letters and Science during the preceding 100 years was published, and it has been decided to undertake the preparation of a special volume on similar lines covering the period of the last 50 years.

# Recent Advances in Palæontology in India.*

By D. N. Wadia,
*Geological Survey of India.*

NOTABLE contributions to our knowledge of palæontology in India during the last 20 years have been along three main lines: (1) the investigation of the invertebrate palæozoic faunas from the ancient life-provinces of the Salt Range, Kashmir, the Chitral and Pamir region, and the Shan States of Burma; (2) the study of the rich mammalian faunas entombed in the Siwalik and older Tertiary fresh-water deposits of the Himalayan foot-hills and those of the Baluchistan and Burma highlands; (3) the detailed examination of groups of marine Mesozoic and Eocene[1] fossils, *e.g.*, the Jurassic cephalopods of Cutch, the Danian faunas of the *Cardita beaumonti* horizon, the basal Eocene mollusca of the Ranikot series and the Eocene foraminifera from the calcareous mountains of the north-west. To these must be added the revision of the fossil floras of the Gondwana system in accordance with the advances in palæobotany that have been made since Feistmantel carried out his pioneer investigations on the terrestrial fossil vegetation of India between the years 1863-86.

A number of important monographs on the fauna of the older Palæozoic and the "Anthracolithic" formations of the Himalaya, Burma and Salt Range by Dr. F. R. Cowper Reed,[2] have brought the problem of the geographical distribution of the life-provinces in the Palæozoic seas of India nearer satisfactory solution. In the field of invertebrate palæontology in India, Dr. Reed is the successor to Prof. Carl Diener of Vienna, who for many years before the War was a most valued collaborator of the Geological Survey of India in working out its collections of the faunal wealth of the Spiti, Kumaon and Kashmir Himalayas. As a consequence of detailed palæontological study, following closely on systematic mapping and collecting in the field by officers of the Geological Survey, the age of Permo-Carboniferous glaciation of India, a most important datum-line in the geology of the whole of the ancient southern continent of Gondwanaland, is now deduced with considerable precision to belong to a horizon at the base of the Uralian[3] or the top of the Moscovian stage—a horizon which is now accepted by Indian geologists as forming the bottom of the Lower Gondwana system of deposits in all parts of India.

Dr. G. E. Pilgrim[4] (now retired from the Geological Survey of India) has been the chief investigator of the Tertiary mammals of India during the last two decades. His notable contributions are memoirs on the Eocene ungulates from Burma, the Lower Miocene anthracotheroids from the Bugti hills of Baluchistan, the fossil pigs, giraffes and carnivores of India, together with a forthcoming comprehensive review of the hollow-horned ruminants which are so prolific in the Siwaliks. In a very suggestive paper† Pilgrim has discussed the problem of the inter-relations and migrations of the various groups of pre-historic mammals into and out of India during the Siwalik epoch, when India's population of the higher mammals was far greater than it is to-day. An important element in the mammalian fauna of the Siwaliks consists of the remains of creatures belonging to the most highly developed order of the primates, these constituting some 12 genera of anthropoid apes, extending in stratigraphic range from middle Miocene to early Pleistocene. The fossil primates so far discovered are, however, unfortunately very fragmentary and in the present stage of our knowledge no definite conclusions as to the probable lines of descent of these forms and their position with respect to the line of human ancestry in India can be safely drawn, yet the proof of the presence of a vigorous and highly differentiated family of the anthropoid apes (Simiidæ) in an epoch directly anterior to that of man, suggests that the idea of the existence of Upper Siwalik Man in India (the yet undiscovered Sivanthropus) may not be merely a dream.

Since 1920 our knowledge of the Mesozoic reptiles of India, especially of the extraordinarily diversified order Dinosauria, has been greatly increased by the finding of large quantities of vertebræ, skull, limb and

* By permission of the Director, Geological Survey of India.

†Presidential Address, Geology Section, Indian Science Congress, Benares, 1925 (Asiatic Society of Bengal, Calcutta).

girdle bones, armour-plates, and teeth, from the Jubbulpur district, by Dr. C. A. Matley, working in co-operation with the Geological Survey. The systematic description of this material by Prof. Von Heune of Stuttgart, a recognised authority on fossil reptiles, and Dr. Matley,[5] has added 12 new genera and many species to the list of Indian dinosaurs, including the first records of the sub-orders Coelurosauria and Stegosauria in this country. The dinosaurs reached their highest development in India during the Lameta age in the Upper Cretaceous period.

Dr. L. F. Spath of the British Museum has completed his revision of the Jurassic Cephalopoda of Cutch, comprising 556 species of ammonites divided into 114 genera, the majority of these being the author's own creation, in six bulky memoirs of the *Palæontologia Indica*.[6] Dr. Spath has discussed interesting questions of Jurassic zoogeographical provinces, the affinities and comparisons of contemporaneous faunas from other parts of the world and the fascinating problem of ammonite phylogeny, in the investigation of which he finds the Hæckelian theory of Recapitulation, or as it is termed, "Biogenetic law", quite inadequate. The main elements of the Cutch fauna, according to Spath, are more closely linked to the fauna of the Indo-Madagascar province than to the Mediterranean (*i.e.*, Tethyan) area.

Among other noteworthy palæontological work of recent years may be mentioned the establishment of a remarkably well-developed Cambrian system in Kashmir,[7] containing a highly differentiated, but strongly provincial, fauna of trilobites, and of the Neocomian and Albian horizons in the Cretaceous of the Kohat[8] area. The value of Foraminifera as zone fossils in stratigraphic correlations of stages and sub-stages of the extensive Eocene and Oligocene calcareous development of the north-west, is brought out by the work of W. L. F. Nuttall and L. M. Davies. Palæontological research, there appear reasons to believe, may be the deciding factor in settling the much-vexed question of the age of the 'saline series' of the Punjab Salt Range and of the existence of powerful thrust-faults at the foot of the range. In this connection the recent discovery of foraminifera and fish remains by Mr. E. R. Gee of the Geological Survey of India from the Salt Marl associated with the salt deposits of these mountains is a notable event.

The pre-eminent position occupied by the Gondwana system among the stratified formations of the Peninsula has, from the earliest days of Indian geology, enforced attention to palæobotanical studies, not so much for the purpose of establishing chronologies, (for which the value of the evidence of plant fossils is still not fully established) but for the classification and inter-correlation of stages of the various widely scattered Gondwana outcrops of India from Kashmir in the north-west to the mouth of the Godavary in the south-east. In 1920 Seward and Sahni published a memoir on the revision of some Gondwana plants; this paper has drawn attention to the necessity of a comprehensive re-study of the great store of plant petrifactions, impressions, woods, fructifications, etc., belonging to the original material worked out by Feistmantel, as well as that collected by the Geological Survey during the last fifty years. The recognition of the Pteridosperms as a group distinct from the ferns and of the Bennettitales as distinct from the Cycads, along with the improved methods and technique of investigation of fossil plant-tissues that have come into use during recent years, have already caused considerable modifications in the grouping and nomenclature of Gondwana plants. Since 1925 the work of revision has been carried out by Prof. B. Sahni of Lucknow University and two memoirs dealing with the Coniferales,[9] besides several smaller papers on subjects of special interest, have already been published. Prof. Sahni is at present engaged on a comprehensive study of the post-Gondwana fossil Monocotyledons collected from various parts of India.

A magnificent collection of animal and plant fossils, the result of nearly seven decades' collecting by the Geological Survey, is stored in the galleries of the Indian Museum at Calcutta. Free access to these collections is given to both students and specialists and the Museum is indirectly furthering palæontological research by its system of exchange and presentation of duplicate specimens, casts, etc., to Museums of many parts of the world. Last year the Indian Geological Survey co-operated with the Yale University expedition in making large collections of invertebrate and vertebrate fossils from the Permo-Carboniferous of the Salt Range and the Siwalik deposits of the Potwar, Simla and Kangra areas, and with the British Museum Percy Sladen

Trust party in collecting fossil reptilian remains from the Central Provinces.

A welcome sign of the time is the interest taken in palæontological work by some of the younger workers in Indian geology. Considering the serious and often unsurmountable limitations to palæontological research by those beyond the reach of organised departmental centres, *e.g.*, properly equipped libraries and museums, the progress, though yet not great, gives cause for satisfaction. Besides some excellent palæobotanical work produced by Prof. Sahni's students, the Zoology and Geology departments of the Mysore University, the Geology laboratory of the Presidency College, Calcutta, and, lately, that of the Benares Hindu University are making creditable endeavours to start palæontological research on the right lines.

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## The Indian Sugar Committee Meeting at Coimbatore.

THE Sugar Committee of the Imperial Council of Agricultural Research held its sixth meeting at Coimbatore on the 14th, 15th and 16th November 1933, under the Chairmanship of Dewan Bahadur Sir T. Vijayaraghavachariar, Vice-Chairman of the Imperial Council of Agricultural Research. Of all the Committees set up by the Council, the Sugar Committee has been the most active and has contributed materially to the development of the Sugarcane Agriculture and Sugar Industry of India. Within the space of three years, the achievements and the future programme of the Committee have gone far beyond the expectations on a five-year plan. This is evident from the periodical reports of the discussions of the Committee, which having provided adequately for the growth and development of sugarcane agriculture and industry, is applying itself to problems on the equal distribution of profits between the grower and the miller, to the establishment of a central Sugar Research Institute, and to the profitable utilisation of the by-products and waste products of the industry. The grant of protection to the industry and the creation of new and better varieties of sugarcane by Rao Bahadur T. S. Venkataraman, have been responsible for the phenomenal development of the sugar industry in this country. While in 1930-31 only twenty-nine sugar factories were operating in India, fifty-seven factories were in operation in the season 1932-33, and a total of over 120 factories are expected to operate during the coming season.

This being the first time the Committee visited Coimbatore, the several members went round the thick and thin breeding stations and acquainted themselves with the several phases involved in the evolution and distribution of improved varieties of sugarcane. Rao Bahadur T. S. Venkataraman, the Government Sugarcane Expert, and Mr. N. L. Dutt, the Second Cane Breeding Officer, showed the members and visitors round and explained to them the several phases of the science and art of sugarcane breeding, their joys and sorrows in the preliminary selection and rejection of seedlings and their successes and failures and hopes. Mr. Venkataraman also showed the interesting collections of wild sugarcanes and his new creations—the sugarcane x sorghum hybrids —and wound up with a graphic description of how his cane breeding station had already materially contributed to the advancement of the cultivator and the industry and what further improvements could be expected. These morning visits besides enabling the Committee to gain first-hand knowledge of

the fundamental work leading to the growth of the industry, were instructive to the lay visitor in showing what science, state protection and direction by a committee of experts in the line can do.

Of the several items of business transacted by the Committee, judging from the press reports, the most important and the most difficult subjects discussed were those dealing with the distribution of profits, the establishment of a Central Sugar Research Institute and the utilisation of molasses for power alcohol production.

The discussion on the distribution of profits and the methods of doing it is a subject of considerable interest all round and is beset with several difficulties. The grower and the miller are the active participants in sugar production and it is therefore reasonable that both should participate equally in the profits. It should be more assuredly so, when there is protection. While the axiom is easily stated, there are several practical difficulties in devising ways and means of ensuring the equal distribution of profits. This was one of the subjects discussed at the Simla Sugar Conference in June last without arriving at a decision. Since then, there have been several discussions in the press both from the point of view of the grower and the miller. Some suggest the raising of the price of jaggery or gur, some suggest the removal of surcharge, while some opine that the miller in his own interests will necessarily have the interests and the well-being of the grower at heart. None of these suggestions, however, adequately solves the problem. Each is defective in one way or the other and there are several opportunities for abuse. This being so, it is gratifying to note that the Committee tackled this difficult problem carefully and have taken the first step forward in recommending that legislation should be undertaken by which the price paid to the grower would be linked up with the profits made by the sugar factory and in suggesting that each province should legislate according to its conditions. While this is satisfactory so far as it goes, the means of attaining the end remains to be settled. Various formulæ were suggested for linking the price paid to the grower with the profits made by the factory. These have obvious advantages and are attendant with all the alleged risks existing now. The problem is not peculiar to India. It was in existence in the beginning in all the sugar-producing countries but was eventually solved by arriving at suitable working arrangements. It will be interesting to examine their methods of dealing with the problem.

Sugarcane for mills is generally grown under one or more of three systems: 1. entirely by the mills (rare in India but a regular feature in Java), 2. entirely by agriculturists (the usual practice in India), and 3. partly by mills and partly by agriculturists. The question of payments comes in only in the case of 2 and 3. In Java, the factories usually raise their own cane. When they buy sometimes, they do so from large estates on an agreement by which the profit is equally shared. On the side of the estate the total cost of growing cane and delivering it at the factory weigh-bridge are computed and the mill in its turn calculates the total costs of manufacture, packing, etc. Samples of cane at 5 to 10 per cent. of the quantity delivered are crushed and analysed daily and the available sugar on cane is calculated by a formula which varies with the variety of cane. In Mauritius, the agriculturist gets two-thirds of the sugar produced in the factory in return for the cane supplied. In Queensland the price of cane paid to the growers by the mills is strictly under the supervision of the Government who appoint for the season, at each mill, a Government Check Chemist whose business it is to see that sampling and analyses of consignments of cane, are properly done. In the British West Indies, the payment is made on a basis of 55 per cent. of the value of D. C. sugar manufactured for commerce. The system of payment in Antigna is that the planters receive as a first payment the value of 4½ pounds of 96° sugar for every hundred pounds of cane supplied and at the end of the season they receive a further payment on the basis of fifty-fifty participation in profits. Natal and Zululand in South Africa, according to Maxwell, stand alone in the matter of irrational payment for cane based on weight and with no reference to quality. It is therefore clear that the regulation of payment for cane is not, after all, an impossible proposition. The great difficulty in India is that sugarcane cultivation is largely in the hands of peasants and generally illiterate farmers, who employ a middleman to sell their crop to the factory, but this is not an insuperable difficulty. The first requisite is the evolution of a formula by which it should be possible to calculate approximately from

the analysis of first mill juice, the amount of available sugar and there should be no difficulty in obtaining this information if the mills and departments of agriculture set to work together.

An item of considerable interest is the decision of the Committee to establish a Central Institute for Sugar Research. As would be expected, the earliest efforts at resuscitating and establishing the Indian Sugar Industry were first directed towards the most promising and fruitful lines of work. On one side impetus was given for the production of raw material by way of evolving new varieties of sugarcanes and by encouraging provincial agricultural departments, with or without grants from the Council funds, in carrying out cultural and manurial experiments, by setting up an organisation to study the economics of sugarcane cultivation and by bestowing attention on the technology of sugar manufacture. Progress in these directions having reached a definite stage, the Committee have recognised the necessity for sustained and comprehensive research and at its Coimbatore meeting approved separate schemes for research on the Chemistry and Anatomy of sugarcane and sanctioned the establishment of a Central Institute for Sugar Research. In these days of rapid scientific progress and severe competition from outside, no industry can hold its own without continued and efficient research in all its phases and more so with sugar industry in India. The methods of cultivation and manufacture developed with older types of imported canes need re-examination and new creations have yet to be studied in greater detail. The indigenous methods of sugar production which are best suited to the conditions of the peasant cultivator need examination and modification. The older ones were largely empirical and are rule of thumb methods which the cultivator himself has worked out with almost scientific precision. The methods vary widely in different areas and are applicable strictly to the localities in which they are developed. When attempts are made to translate practices from one locality to another they have, as would be expected, the disconcerting habit of failing frequently because of their empirical nature. In spite of the rapid progress in white sugar production, jaggery or gur making will continue, at any rate for some decades, to be an important product of sugarcane. While all the facilities that science offers are readily requisitioned for service in the manufacture of white, crystalline sugar, the application of science and the development of suitable methods for jaggery or sugar production on a cottage industry basis, has not received adequate attention. It is, therefore, pleasing to note that the Committee have not lost sight of this problem of tremendous importance to the peasant cultivator and provided for research in this field. In this connection the members of the Sugar Committee were very much interested to see at the Central Farm of the Agricultural College and Research Institute the whole of the new process of Cream jaggery manufacture with the use of activated paddy husk charcoal recently evolved at Coimbatore and the Committee were impressed with the simplicity of the process and the superior quality of the product. Completeness of organisation for research and its centralisation are essential for success and the Committee have not only recognised this but have taken the big step forward in sanctioning the establishment of a Central Sugar Research Institute.

The Committee spent anxious time and thought on the problem of the production of power alcohol from molasses and on the consequential legislation for its use, blended with petrol, as motor fuel. The problem of molasses disposal is a necessary evil arising out of white sugar industry. In October 1932 this subject was under discussion at Coimbatore jointly by the Society of Biological Chemists (India), the Indian Chemical Society (Madras Branch) and the Association of Economic Biologists. Within one year from that date, the problem gained both in size and momentum and ranked itself as one of the most urgent problems facing the sugar factories. Representatives of sugar factories were anxious to have legislation permitting the production of power alcohol and for the compulsory use of a mixture of alcohol and petrol as motor fuel. The proposition is attractive but is beset with several practical difficulties. In dealing with this subject the Sugar Committee was cautious and decided that the most important step was to carry out an experiment for the marketing and distribution of power alcohol in admixture with petrol as motor fuel in a limited area. This decision while providing adequately for research on the most urgent problem of the factory owner, does not involve the public in uncertainties and losses attending

on compulsory general legislation. The alcohol-petrol blend as a source of fuel for internal combustion engines is not yet an entirely successful and proved proposition fit for universal adoption. It is true it is being used in Germany, France and Italy. In America, where it is said to be in vogue, the American Automobile Association carried out several investigations in co-operation with the Secretary for Agriculture early in 1933 and issued two leaflets dated March and June 1933. According to the report of the American Automobile Association, alcohol is materially lower in heat value than gasoline and therefore requires adjustment of carburettors for equal performance compared with gasoline. Alcohol has the property of absorbing moisture and this results in the separation of alcohol and petrol in the blend and involve carburation and starting difficulties. In addition, increase in maintenance cost of motors may be expected owing to the deleterious effects on various parts of the system. Based on these observations, the Board of the American Automobile Association finally stated that hundreds of tests conclusively showed that an alcohol gasoline blend would be a great deal less efficient than regular gasoline and that its universal and compulsory use would add to the cost of up-keep. In the light of this experience, the decision of the Sugar Committee to carry out preliminary experiments is undoubtedly based on a very careful examination of the question in its several aspects.

This is about the disposal of factory molasses. There is still the problem of the disposal of molasses from small factories which manufacture white sugar by the open-pan system. The accumulations from individual factories may be small relatively, but in the aggregate the quantity of molasses produced will be larger than that from big factories. Even if the manufacture of power alcohol and its use as motor fuel with petrol materialises, it will not be a paying proposition for the open-pan sugar producing concerns to transport his molasses to a central distillery. The disposal of this type of molasses still constitutes a problem, and calls for investigation. Taking everything into consideration the most promising line of development appears to lie in the use of molasses in agriculture itself for manurial and feeding purposes. This kind of disposal is already in vogue in Java, Hawaii and other sugar-producing countries, but it is necessary to carry out investigations with reference to Indian conditions before agricultural departments in India are in a position to make specific recommendations. A comprehensive scheme of research on the effect of molasses on the soil in regard to its physico-chemical and bio-chemical characteristics, on its effect on crops and on its value in the feeding of farm animals has been in progress at Coimbatore this year and some interesting and valuable data have already been obtained.

When considering the Indian Sugar Industry one has always to remember that the Industry will need to face World competition if and when protection is withdrawn in the fulness of time and the utilisation of waste and bye-products is one way of stabilising the Industry against such competition.

The Committee also considered and discussed annual reports of the various schemes previously sanctioned and fair progress was evidenced in all directions.

B. VISWA NATH.

## Indian Science Congress.

### IMPORTANT NOTICE.

OWING to the continued plague epidemic in Poona which has only slightly abated, the venue of the Congress at Poona would have entailed special measures, such as obligatory inoculation of all visitors. The Local Committee, as well as the Congress authorities, have very carefully considered the situation and finally decided to avoid the inconvenience and possible danger of a meeting at Poona. In consultation with the University authorities in Bombay it has been decided to transfer the venue of the Congress from Poona to Bombay. The original date of the opening of the Congress (2nd January) remains unaltered.

## Letters to the Editor.

### Negative Viscosity of Solutions.

JONES AND DOLE (*J. Amer. Chem. Soc.*, **51**, 2950, 1929) and Falkenhagen and Dole (*Phys. Z.*, **30**, 611, 1929; also see Falkenhagen, *Phys. Z.*, **32**, 745, 1931) have treated the problem of the variation with concentration of the relative viscosity of electrolytes from the standpoint of the ion-atmosphere theory of Debye and Hückel and shown that at high dilutions the electrolyte must always increase the viscosity of the solvent and that the relative viscosity of an electrolyte solution at high dilution must be represented by an equation of the form

$$\eta_c/\eta_o = 1 + K\sqrt{C}$$

where $\eta_c$ is the viscosity of the solution,
$\eta_o$ is the viscosity of the solvent,
C is the equivalent concentration, and
K is a constant which can be determined in terms of certain constants of the electrolyte and the solvent.

It is well known that certain salts of some of the alkali metals show "negative viscosity" within a certain range of concentration, *i.e.*, the solutions are less viscous than the pure solvent. According to the theory of Falkenhagen and Dole, in very dilute solutions the viscosity should increase with concentration upto a certain stage even in instances of negative viscosity. A tendency to this effect was noticed by Schneider ("Dissertation", Rostock, 1910) in the case of potassium chlorate and by Bousfield (*J. Chem. Soc.*, **107**, 1781, 1915) in the case of nitric acid.

Recently Joy and Wolfenden (*Nature*, **126**, 994, 1930; *Proc. Roy. Soc.*, **134**, 413, 1932) have shown by very accurate measurements that the viscosity of solutions of potassium chloride, potassium chlorate, rubidium nitrate and nitric acid at high dilutions is greater than that of pure water and that the limiting slopes of the $\eta_c/\eta_o$, $\sqrt{C}$ curves and their temperature coefficients agree, within the experimental error, with the values predicted by the Falkenhagen-Dole equation.

In our laboratory we have carried out recently measurements of viscosity at 30°C with an Ostwald viscometer of solutions of chlorides, iodides and nitrates of potassium and ammonium in water and methyl, ethyl and n-propyl alcohols and observed the following:—

(1) Chlorides, iodides and nitrates of potassium and ammonium in aqueous solutions show negative viscosity within a certain range of concentration (*cf.* Getman, *J. de Chim. phys.*, **5**, 344, 1907; *J. Amer. Chem. Soc.*, **30**, 721, 1908; Herz and Martin, *Z. anorg. Chem.*, **132**, 31, 1924; Simon, C. R., **176**, 437, 1923 and others).

(2) In methyl and ethyl alcohols potassium chloride and ammonium chloride alone show negative viscosity.

(3) In n-propyl alcohol only a tendency for negative viscosity is marked in the case of potassium chloride.

(4) In all the above cases of negative viscosity, the relative viscosity increases with concentration upto a certain stage in very dilute solutions.

The last observation is in agreement with the requirements of the Falkenhagen-Dole theory. The observations with the Ostwald viscometer in dilute solutions are however not so accurate as can be used to test the theory quantitatively. These cases of negative viscosity are being investigated by using a more appropriate type of viscometer with an automatic arrangement to record time of flow.

H. N. DESAI.
D. B. NAIK.
B. N. DESAI.

Physics Laboratory,
Wilson College,
Bombay, 7,
*September 22, 1933.*

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### A Formula for the Variation in the Scattering of Light in Colloids during Ageing and Slow Coagulation.

IN a previous communication I have stated that the time-Tyndall intensity curves obtained with silicic acid sols during ageing are distinctly S-shaped, being curved convex to the time axis at the commencement and becoming concave towards the end. An explanation for this was offered, and an equation was then derived, which was found to represent the variation of the intensity of scattered light with time very well. The general equation is:—

$$I = c + \frac{k}{1 + b \cdot e^{-at}}$$

where I is the intensity of scattered light, $t$ is the time from the start, and $a$, $b$, $c$ and $k$ are constants, which could be found by

calculation for a particular sol. The following tables give the calculated and observed values of the Tyndall intensity, and it will be seen that the agreement is good.

*Sol. A.*—

$$I = 5{\cdot}7 + \frac{24{\cdot}28}{1 + 126{\cdot}71 \cdot e^{-0.1146.t}}$$

| Time | I (Cal.) | I (Obs.) |
|---|---|---|
| 10 days .. | 8·1 | 8·0 |
| 13 ,, .. | 10·5 | 10·5 |
| 16 ,, .. | 14·2 | 14·3 |
| 18 ,, .. | 17·3 | 17·4 |
| 20 ,, .. | 20·4 | 20·0 |
| 23 ,, .. | 24·5 | 25·0 |
| 27 ,, .. | 27·7 | 27·6 |
| 30 ,, .. | 28·9 | 29·0 |

*Sol. B.*—

$$I = 7{\cdot}4 + \frac{18{\cdot}63}{1 + 146{\cdot}82 \cdot e^{-0.1271.t}}$$

| Time | I (Cal.) | I (Obs.) |
|---|---|---|
| 8 days . | 8·6 | 8·7 |
| 9 ,, .. | 9·0 | 9·0 |
| 10 ,, .. | 9·5 | 9·5 |
| 11 ,, .. | 10·1 | 10·0 |
| 13 ,, .. | 11·7 | 11·6 |
| 14 ,, .. | 12·8 | 12·8 |
| 15 ,, .. | 14·0 | 14·0 |
| 18 ,, .. | 18·0 | 19·0 |
| 20 ,, .. | 20·5 | 20·5 |
| 22 ,, .. | 22·5 | 22·0 |
| 29 ,, .. | 25·5 | 24·6 |

Similar S-shaped curves have been obtained by me while examining the variation of the scattering of light and viscosity with time during the formation, ageing, and slow coagulation of colloidal solutions, and have also been observed by others in the case of the change of viscosity with time during coagulation. It has already been recognised that results such as those given above cannot be represented by von Smoluchouski's equation for coagulation. But the equation suggested above, fits in very well with the data on ageing and slow coagulation obtained by me and other workers, and can easily be derived from theoretical considerations, as will be shown in a paper to be published shortly.

I pointed out the usefulness of this equation in an address to the Nagpur Chemical Society about three years ago. Recent investigations have convinced me that it could be applied with advantage to the results giving the variation of light—scattering in sodium oleate solutions with time at 20°C, and in the formation and slow coagulation of sols.

K. KRISHNA MURTI.

College of Science,
Nagpur, C. P.,
*October 10, 1933.*

## Physics of the "Smell".

PROF. BOHR in his recent address[1] on 'Life and Light' has emphasised the peculiar organisation of living beings with a view to understanding their essential characteristics. This organisation exhibits typical atomistic and quantum traits combined with the ordinary mechanical characteristics, in a manner having no counterpart in inorganic matter.

As an illustration of the refinement to which this organisation is developed, Prof. Bohr has considered the case of the human eye. The eye is an ideal and perfect optical instrument inasmuch as its resolving power and its sensitiveness have reached the limit imposed by the wave and quantum nature of light. It has been found that the eye can be stimulated by a few light quanta (or possibly a single light quantum ?). Further the optical resolving power [$(5/d^n)^\circ$ where $d$ is the aperture of the eyelens in inches] and the physiological resolving power (angle subtended by the "cone" in the retina at the eyelens) of the eye are almost the same. This perfection of the eye naturally leads one to expect that the other organs also may reveal similar characteristics, the study of which will greatly help in establishing the relation between organic evolution and physics.

A consideration of the construction and function of the nose may also afford another interesting example. The human nose appears to be very sensitive to smell. However, physics corresponding to the sensation of smell does not exist at all, though physics of the eye and the ear (being simpler) has developed so much.

It is of interest to see whether the sensitiveness of the nose has also reached a

[1] *Nature*, March 25 and April 1, 1933.

limit imposed by the atomic character of substances giving rise to the sensation of smell; *i.e.*, whether the sensation of smell can be excited even when there be present a few molecules (or a single molecule?) of an intensely smelling substance. Any data that might be obtained in this connection are bound to be helpful in the study of the evolution of senses. It is intended to make some tests on this point and we shall be glad to receive information on data concerning this if already obtained.

D. V. GOGATE.
D. S. KOTHARI.

Physics Department,
University of Allahabad,
Allahabad,
*October 24, 1933.*

## A Gall-like Structure from a Tree in the Andamans.

WHILE on a visit to the small tidal creeks between the Cholunga range of hills on the west coast and the Sholl Bay creek on the east coast of South Andaman, I noticed a large number of these gall-like structures on the branches of *Carappa obovata* (Meliaceæ),[1] a medium-sized tree which appears to be a common element of the flora of the swampy banks of the small tidal creeks. The structures have a considerable range in size, the largest collected being over 24 inches in diameter (Fig. 1). The smaller ones are nearly spherical in shape while the larger ones are oblong or kidney-shaped. In colour and in form they resemble superficially the tubers of *Amorphophallus campanulatus*. These were at first mistaken for fruits of *Carappa obovata*, but on closer examination of the tree it was found that the gall-like structures were firmly attached to the branches by tiny roots issuing from the base of the former. Thousands of ants were found swarming on the surface making it difficult to collect the "galls". A vertical median section of the "gall" (Fig. 2) reveals

**Fig. 1**

One small and two large galls from *Carappa obovata*, both from the same tree.

Orchids and other epiphytic plants are also found on the same tree.

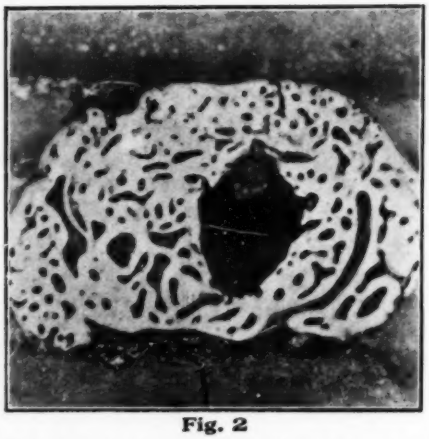

**Fig. 2**

Vertical median longitudinal section of one of the large galls showing the internal chambers.

a hollow space in the centre communicating with the outside by smaller apertures on the surface, and a number of more or less cylindrical passages which branch and anastomose to form a complex system of chambers resembling the interior of a termites' nest. The lining membrane of the chambers is of the same nature as that of the external surface of the "gall". The ants infesting the "gall" seem to breed and lay eggs inside the chambers. Mr. Durgadas Mukerjee of the Calcutta University who was kind enough to examine the ants has provisionally referred them to *Prenolepis bourbonica* Forel from which they differ in certain minor characters. He thinks, however, that they may prove to be a new race of *P. bourbonica*. The chambers are also inhabited by a few immature forms of

[1] I have to thank Mr. K. N. Ayyar, Extra Assistant Conservator of Forests, Port Blair, for identifying the plant.

other insects which are for the moment unidentifiable. The tissues of the "gall" are pith-like in consistency and are full of a watery secretion which seems to dry up very slowly; and it was found that the ants were alive and active for several days after the "galls" were removed from the tree.

It is difficult to say whether the structure described here is a true gall or not, and what the casual relationship of the ant to this structure may be. The presence of root-like structures on the undersurface of the "gall" inclines me to think that it may be an epiphyte like the orchids and other plants found in close association with it on the same tree, but the curious internal structure of the so-called gall appears to be unique. I hope to be able to collect more material with a view to further study.

H. SRINIVASA RAO.

Port Blair,
Andamans,
*November 2, 1933.*

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### *Rhogas aligharensi* sp. n. (A Pink Boll-Worm Parasite).

GOING round the cotton-fields at Aligarh in order to study the Pink boll-worm parasites, a few parasitised larvæ of Pink boll-worm (*Platyedra gossypiella*) were collected. From these larvæ some Hymenopterous parasites of the Family Rhogadinæ emerged out. These were studied and sent out for identification. Prof. Dr. Bischoff of the Universitaet Giessen a.d. Lahn (Germany) very kindly took the trouble of identifying them. He gave them a rank of new species belonging to the genus Rhogas. After a careful study they revealed close resemblance to a boll-worm parasite described from Lyallpore as *Rhogas testaceus* (Grav). The life-history which is very imperfectly worked out at Lyallpore resembles broadly with that of this new parasite found at Aligarh. Differences, however, exist in the structure. The chief points of difference are:—

(1) The number of joints in the flagellum of *R. testaceus* are 31–32, whereas in this Rhogas sp. there are 33–34 joints in the flagellum.

(2) Scape in *R. testaceus* is of a deep yellow colour while it is yellowish brown in these parasites.

(3) Abdomen in *R. testaceus* is yellowish brown ventrally but in these specimens the posterior segments are deep dark brown, especially in females.

(4) The size of females in some specimens was bigger than in *R. testaceus*. The ovipositor is black in colour.

From the field-study it appears that there is an external check on these parasites. In a few cases it was found that out of parasitised host larvæ, adult parasites failed to develop.

The biology and complete life-history of this parasite is under preparation and it will be published elsewhere.

MOHD. AFZAL HUSAIN QADRI.

Zoological Laboratories,
Muslim University,
Aligarh, U.P,
*November 9, 1933.*

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### On the Raman Frequencies of the $NH_4$-Group.

To explain the anomalous result observed in the Raman spectra of solutions of ammonium salts, in which the usual water band is found to be accompanied by another on the side of smaller frequency shift, we investigated the Raman spectra of a number of ammonium salts in the crystalline state and in the state of solution. It is found that the second band, wrongly attributed by some workers to water, is due to the $NH_4$ radical.

Microphotometric records of the spectra are taken to locate the position of the maxima in the $NH_4$ band. The following frequency shifts are obtained: $\delta\nu$=3117, 3169 (?), and 3220 $Cm^{-1}$. in the crystalline state; and $\delta\nu$=3157 and 3221 $Cm^{-1}$. in solution. These correspond to the infra-red absorption band found by Reinkober in ammonium salts at 3·20$\mu$. This band is attributed to the vibration of the N and H atoms parallel to the axis of symmetry in the pyramidal model of the molecule in which the N atom is situated at the vertex and the H atoms at the four corners of the base of the pyramid.

A detailed report of the investigation is communicated to the *Zeitschrift für Physik* for publication.

I. RAMAKRISHNA RAO.
C. SAMBASIVA RAO.

Andhra University,
Waltair,
*November 15, 1933.*

### The Arc Spectrum of Tellurium.

THE arc spectrum of Tellurium has been investigated from the visible down to λ 1600 using an ordinary arc between Acheson Graphite poles containing pure Tellurium as source in the visible and quartz regions. Between λ 2000 and λ 1600 an arc in Nitrogen in the manner used by K. R. Rao,[1] has been photographed by a Vacuum Grating Spectrograph. The data obtained have led to the confirmation of the level scheme of TeI proposed by McLennan[2] and others and also to the identification of the combinations involving the 5d and presumably the $sp^5$ levels of the spectrum. The important intervals $5d\ ^3D_1 - 5d\ ^3D_2$ and $5d\ ^3D_2 - 5d\ ^3D_3$ are 196 and 789 $cms^{-1}$ respectively. Adopting the value 72667[3] for the deepest term $5p\ ^3P_2$ of the spectrum a number of new low-lying energy levels 22624, 20800, 16997, 13923, etc., have been discovered. The detailed scheme will be published elsewhere.

S. GOPALAKRISHNA MURTY.
Science College,
Andhra University,
Waltair,
*November 20, 1933.*

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### On the Feeding Habits of *Belostoma indica*.

THE mode of feeding of this giant water-bug was observed in the Laboratory to elucidate certain points regarding its feeding habits. The bug measured three inches in length and one inch across the thorax. As is well known it floats on the surface of water and if submerged produces the anal tube for respiration.

Tadpoles of various sizes were supplied. Small tadpoles could not be held between the grooved fore femur and tibia partly owing to the small size of the animals and partly that any slight touch would dart them away. Frogs about one inch long and half inch wide were easily caught and held fast between the forelegs and the bug pierced its stylets up to the base at any soft place usually between the arm and belly and sucked out the fluid till the animal was flabby.

Efforts to get away on the part of small frogs were of no avail as the grip was very tight even so much that it was difficult to take the animal away with the forceps.

Larger specimens of frogs were later on supplied and in no case was the bug found feeding as has been described by Herbert Manners [1] or as is shown in the drawing by R. C. Wood. On the other hand such large specimens of frogs moved away or jumped, much frightened, on the approach of the bug.

Artificial attempt to feed on larger frogs revealed further that the skin in these was tough and slippery for the stylets to pierce and the bug left such specimens for want of successful feeding. Pieces of dissected tissue of frog were also caught by the fore legs and feeding was resumed.

Attempts to feed this bug on other aquatic Hemiptera (*Nepidæ*) and water-beetles (*Dytiscidæ*) were unsuccessful probably due to their hard exoskeletons.

U. S. SHARGA.
Entomology Department,
Agricultural College,
Cawnpore,
*November 24, 1933.*

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### A Cranial Abnormality in the Indian Mackerel—*Rastrelliger kanagurata*.

IN the normal cranium of this interesting fish, it will be noticed that there is an epiotic on either side of the supraoccipital and above the exoccipital. The epiotic has three outer surfaces—dorsal, lateral and posterior and is pointed postero-laterally. The dorsal surface of the bone sends antero-inwards a thick ridge which is continuous with a similar one from the supraoccipital and forms the upper edge of the posterior surface of the cranium. The lateral surface forms the inner wall of the temporal groove and the posterior surface contributes to the posterior wall of the cranium. The inner or the cranial surface of the bone has a small and a large recess. The two recesses are partly separated by a thin ridge, and are in continuation with each other at the base. The posterior semi-circular canal enters the wide recess and comes out of the bone through the smaller one.

In the specimen under consideration the left epiotic is absent and in consequence of

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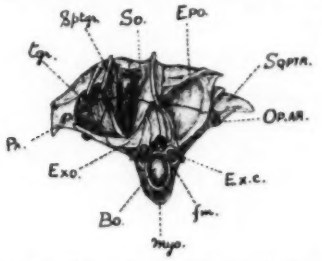
[1] *Proc. Roy. Soc.*, **A. 124,** 465, 1929.

[2] *Phil. Mag.*, **4,** 486, 1927; also *Nature*, **124,** 874, 1929.

[3] Ruedy: *Phy. Rev.*, **41,** 588, 1932.

[1] Maxwell-Lefroy, H., *Indian Insect Life*, pp. 714-764.

this, considerable changes have taken place in the posterior region of the cranium. The supraoccipital bends considerably posterolaterally on the left side and articulates directly with the squamosopterotic and the exoccipital. The supratemporal groove on the left side has become very deep and extends even over the exoccipital. The exoccipital has developed a thin vertical ridge which is continuous with the ridge of the parietal forming the outer and inner




The Posterior View of the Abnormal Cranium of *Rastrelliger kanagurata*. (×2)

Bo.=Basioccipital. Epo.=Epiotic. Ex.c.=Exoccipital condyle. Exo.=Exoccipital. fm.=foramen magnum. myo.=posterior opening of the myodome. Op.ar.=Opisthotic articular facet. Pa.=Parietal. So.=Supraoccipital. sptgr.=supratemporal groove. Sqptr.=Squamosopterotic. tgr.=temporal groove.

walls of the supratemporal and temporal grooves respectively. The exoccipitals, with the foramen magnum, have slightly shifted to the right side. The articular condyle of the right exoccipital and also the articular facet of the right opisthotic (for the lower limb of the post-temporal) are more prominently developed than in normal crania. And the same structures on the other side of the cranium are ill developed. The cranium is being worked out in detail in this laboratory and a complete account is proposed to be published soon elsewhere.

M. JAYARAM NAIDU.
B. S. BHIMACHAR.

Zoological Laboratory,
University of Mysore,
Bangalore,
*November 1933.*

## Hydro-Electric Schemes in India.

WITH reference to the letter of Dr. H. E. Watson on page 54 of the August issue of your *Journal*, the following information may be useful:—

I. It is true that other Power systems in India have adopted 50 cycles as the frequency; but Mysore has not been cut off from all co-operation with her neighbours on that account. On the other hand, Mysore has taken the lead and set an example in such co-operation. In the year 1928, the Government of Madras were considering various plants to put up a temporary Diesel Engine Power Station of about 4,000 E.H.P. to supply electricity to drive various machinery connected with the construction of the gigantic dam across the Cauvery River at Metur. The Government of Mysore considered this a suitable opportunity to help Madras and offered Cauvery Power from Sivasamudram at such a reasonable rate that the Madras Government abandoned their Diesel Engine Scheme and entered into negotiations with Mysore with the stipulation that electric power to be delivered to them must be of 50 cycles, 3-phase and 3,300 volts to suit their Transformers and Motors. A double circuit 63 mile High-tension Transmission line (35,000 volts) was built, and step-down plant was installed at Metur, which included suitable Frequency Changers to convert power from 2,200 volts, 25 cycles to 3,300 volts, 50 cycles. The system has been working satisfactorily for the last five years and has saved the Madras Government a few lakhs of rupees and incidentally benefited Mysore.

II. In the event of general Railway Electrification Mysore will have no special difficulties. The standard system for traction adopted by the G. I. P. and South Indian Railways is 1,500 volts D. C. and any power scheme with A. C. power of 50 cycles or 25 cycles has to install Rotary Converters or mercury arc rectifiers to convert A. C. power to D. C. just as the above Railways have done.

III. So far as Electric Power Machinery are concerned it is just as easy to obtain 25 cycle equipment as 50 cycle. The bigger machines are so special that they are built to order and it is only a matter of design to construct them for 25 cycles. Small size Motors and Transformers of 25 cycles have been standardised by the bigger Electrical Manufacturers of the world and they are easily available.

IV. People at Sivasamudram and Kolar Gold Fields have been using 25 cycle power for lights for the last 31 years, and their eye-sight is as good as ever. In these days

when frosted lamps are available at the same rates as ordinary lamps, the flicker effect is also eliminated. The Cities of Bangalore and Mysore are provided with higher frequency power for lighting purposes by the installation of frequency changers. In course of time other centres may also be equipped with frequency changers when conditions are favourable. The Government of Mysore and their Engineers are in touch with the latest developments in the field of Engineering and their Power Stations are equipped with up-to-date apparatus. Whatever useful measures are necessary are generally carried out even if they involve heavy expenditure. But even in Europe and America Frequency standardisation does not always mean the entire changing over of all the machinery in a long-established 25 cycle system. By suitable frequency changers they have linked the 25 cycle systems with 50 cycles, keeping the expenditure within reasonable limits. There are possibilities in the near future of the use of "Inverters" for changing from one system to another and Mysore will not lag behind in carrying out such modifications in the Power Scheme as are found necessary and useful.

B. K. RAM PRASAD.

Power Station,
Sivasamudram,
*November, 1933.*

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## On the Statistical Theory of Solutions.

IN a recent paper Guggenheim[1] claims to have derived thermodynamical formulæ for solutions by the application of Fowler's statistical method, without assuming the validity of the gas laws. He, however, uses the relation $F = E - TS + PV$ which is only true if gas laws are applicable to solutions. In the present note we shall indicate a more straightforward method, based on generalised Gibbs' statistics[2] for obtaining some common thermodynamical relations for solutions.

Consider a system of $n$ components capable of existing in the vapour and the liquid phase. The volume in the liquid phase $V = V^*$ (1-rep) where again $V^* = N_A V_A^* + N_B V_B^* + ..$ $V^*$ being the total volume at very low pressure, $V_A^*$, $V_B^*$ etc. being the same per molecule of $a^{th}$, $b^{th}$.... types. $N_A$, $N_B$.... are the number of these molecules and $n$ the compressibility. The volume due to $i^{th}$ kind of molecules

$$V_i = \frac{N_i V}{N_A + N_B + \ldots + N_n} \qquad .. \quad (1)$$

assuming no interaction.

In the liquid phase the volume is taken to be practically constant. We then have the familiar equations of classical statistics

$$N_i = \frac{V}{h^3} \int e^{\frac{\psi_i - u_i - \omega_i}{kT}} \Delta T_p$$

$$= \frac{(2\pi m_i kT)^{3/2}}{h^3} V \cdot e^{\frac{\psi_i - \omega_i}{kT}} \qquad .. \quad (2)$$

(For liquid phase)

$$N_i' = \frac{(V' - b)\,(2\pi m_i' kT)^{3/2}}{h^3} e^{\frac{\psi_i'}{kT}} \qquad .. \quad (3)$$

(For gaseous phase)

$b$ being Van der Waal's correction and $\omega_i$ the additional work term for the liquid phase (corresponding to heat of solution). For equilibrium

$$\psi = \psi' \qquad .. \qquad .. \qquad .. \quad (4)$$

Substituting $p_i = \frac{N_i' kT}{V - b}$ and using $p_i^\circ$ for the pressure when only the $i^{th}$ kind of molecules are present, we have from (1), (2), (3) and (4)

$$p_i = p_i^\circ \frac{V_i}{V} = p_i^\circ \frac{N_i}{N_A + N_B + \ldots + N_n} \qquad (5)$$

which is the generalised form of *Raoult's Law.*

Again using the relation $\frac{d\psi_i}{dp} = V_i \qquad (6)$

and considering osmotic pressure to be the difference of pressure due to the solution and pure solvent in equilibrium we have

$$\pi = (\psi_i - \psi_i^\circ)/V_i$$

$$= \frac{kT}{V_i} \log \frac{N_A + N_B + \ldots + N_n}{N_i} \qquad .. \quad (7)$$

which is the generalised formula for *osmotic pressure.*

For imperfect solutions $N_i$ is to be everywhere replaced by $N_i f_i$, $f_i$ being the activity coefficient.

*Henry's Law.*—From (2), (3) and (4) we have

$$\frac{N_i}{V} = c_i = k p_i \qquad .. \qquad .. \qquad .. \quad (8)$$

where $k = \frac{1}{kT} e^{\omega_i / kT}$, and $N_i$ is the number of gas molecules present in solution.

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[1] Guggenheim, *Proc. Roy. Soc.*, **A 135,** 181 (1932).

[2] Kar and Mazumdar, *Z. Phys.*, **55,** 546 (1929); also Kar and Ganguli, *ibid.*, **62,** 5101 (1930).

*Nernst's Distribution Law.*—We consider an equilibrium of a solute A in two miscible liquids B and C. We then have corresponding to (2),

$$N_{A_1} = [N_A]_B = \frac{(2\pi m_{A_1} kT)^{3/2}}{h^3} \cdot V_1 \, e^{\frac{\psi_{A_1} - \omega_{A_1}}{kT}} \quad .. \quad (9)$$

$$N_{A_2} = [N_A]_C = \frac{(2\pi m_{A_2} \cdot kT)^{3/2}}{h^3} V_2 \cdot e^{\frac{\psi_{A_2} - \omega_{A_2}}{kT}} \quad .. \quad (10)$$

Now since $\psi_{A_1} = \psi_{A_2}$ we have

$$\frac{N_{A_1}/V_1}{N_{A_2}/V_2} = \frac{c_1}{c_2} = e^{\frac{\omega_{A_2} - \omega_{A_1}}{kT}} = \text{const.} \quad .. \quad (11)$$

If, however, the molecules of A are associated in one of the solvent say C, we have instead of (10)

$$N_{A_2} = \frac{(2\pi m_{A_2} kT)^{\frac{3n}{2}}}{h^3} V_2 \cdot e^{\frac{n(\psi_{A_2} - \omega_{A_2})}{kT}} \quad (10a)$$

when $n$ is the number of molecules associated to form a single molecule. Again equating the free energies we have

$$\frac{c_1}{c_2^{1/n}} = e^{\frac{\omega_{A_1} - \omega_{A_2}}{kT}} = \text{const.}$$

A. GANGULI.

Chemical Laboratory,
College Dupleix,
Chandernagore,
*November, 1933.*

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## Oogenesis of *Clibanarious olivaceus* (Henderson) with special reference to a seasonal variation in the various Cytoplasmic Inclusions.

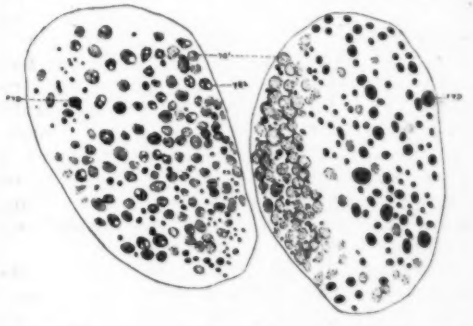
ALMOST all modern work on cytoplasmic inclusions has been done without any reference to environment and no two workers on the same animal have come to identical conclusions. In the case of Patella, Ludford states that the breeding season is in *autumn* and Brambell who studied the eggs of the same animal during the *winter months* has noticed some differences in the chemical composition of the various inclusions, though in the main his results corroborate those of Ludford. Hence, thinking that a study of the cytoplasmic inclusions in Clibanarious from oocytes collected during two different seasons, by all modern cytological methods such as Da Fano, Champy, Bensley-Cowdry, Nassonov, and Mann Kopsch and treatment of eggs in the fresh condition with neutral red, Janus Green. B, Sudan III, Scharlach. R and 2% Osmic acid, was well worth attention, such a study was made during two periods January-February and April-June 1933. A study of the physico-chemical factors, such as, Temperature, Excess Base, pH, Salinity and Chlorine content of the medium was also made.

The Golgi apparatus occurring as an irregular mass in both sets of preparations was seen to break up and give rise to granules which exhibited three different kinds of behaviour. (1) Some of them enlarged into vacuoles and secreted fatty yolk inside their interiors. (2) Some others enlarged into clear vacuoles with chromophilic rims, which by rupture gave rise to Golgi batonettes. (3) Lastly, in April-June preparations some of the Golgi grains metamorphosed into albuminous yolk.

The albuminous yolk consists of two kinds and from the nature of their origin they can be termed Golgi-mitochondrial and Golgi-Golgi albuminous yolk grains.

The former is seen in both sets of preparations. The initial mitochondrial cloud resolves itself into discrete granules which form a concentration at one pole of the egg. Masses of mitochondria clump together and in association with Golgi batonettes give rise to Golgi-mitochondrial albuminous yolk grains.

**2.** Apr.—June. **1.** Jan.—Feb.



Nassonov. × 110. Mann Kopsch.

FYD. = Fatty Yolk Droplet.
$YG^1$. = Golgi Mitochondrial alb. yolk.
$YG^2$. = Golgi-Golgi alb. yolk.

In April-June when fatty yolk droplets are smaller in size and few in number the

unmodified Golgi form a concentration below the mitochondrial polar concentration. These granules also clump together—each being constituted by 6-12 grains—and later become metamorphosed into albuminous yolk. The Golgi batonette which attaches itself retains its identity and condenses in addition nucleolar matter dissolved in the cytoplasm.

A seasonal change in the metabolism of the oocyte was observed and it was found that when the bar was open, with consequent increase in salinity, fatty yolk droplets occurred in large numbers (Fig. 1 FYD) and in April-June when the bar was closed—the salinity becoming correspondingly low—a very large amount of albuminous yolk—Fig. 2 $Yg^2Yg$—was observed.

M. K. SUBRAMANIAM.

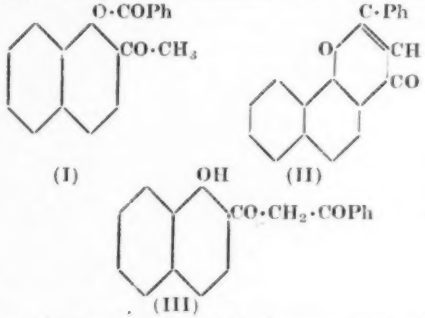
University Zoological
Laboratory,
Madras,
*December 1933.*

Ludford, Reginald James, "Contributions to the Study of the Oogenesis of Patella," *Jour. Roy. Micr. Soc.*, 1921.

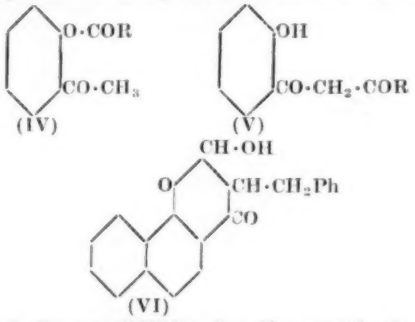
Brambell, F. W. R., "Origin of Yolk," *Brit. Jour. Expl. Biol.*, **1**, 1924.

## A Synthesis of Flavones at Room Temperature.

DURING an investigation[1] of the action of acid anhydrides on phenolic ketones Chadha and one of us[2] attempted to convert 2-acetyl-1-naphthyl benzoate (I) by direct

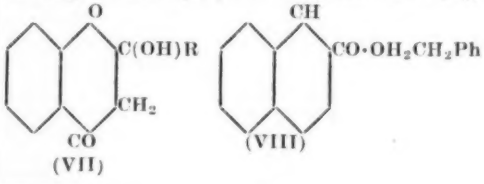



ring closure to α-naphthaflavone (II) with the two-fold object of testing the commonly assumed mechanism[3] of the Robinson reaction and of evolving a method of chromone synthesis which would preclude 3-acylation[4]. The action of sodamide on (I) in either solution has now led to ω-benzoyl-2-acetyl-1-naphthol (III); the mixture was left to stand overnight at room temperature (below 16° throughout), the bulky precipitate being then collected, washed with ether and decomposed with aqueous acetic acid. Treatment of (III) with cold concentrated sulphuric acid in the usual manner gave α-naphthaflavone (II). A smooth synthesis of a flavone has been accomplished below 16°; and the phytochemical significance of this reaction




and its possibilities for the synthesis of natural colouring matters of the flavone group are obvious.

A complete theory of the mechanism of the acid anhydride method of chromone synthesis has been advanced by Baker[5], who has achieved the transformation of o-acyloxyacetophenones (IV) to the dibenzoylmethanes (V) by means of potassium carbonate in toluene at the temperature of the steam-bath during a few hours in yields of 20—40% of the theoretical or at 35° in a yield of 24% after fourteen days. A compound (VI) similar to the 2-hydroxyflavanone (VII), postulated by Baker as the stage through which (IV) is converted into (V),



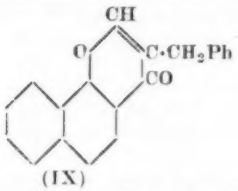

[1] Venkataraman, *J. Indian Chem. Soc.*, *Ray no.*, page 27.

[2] Chadha and Venkataraman, *J. Chem. Soc.*, **143**, 1073, 1933.

[3] Wittig, Baugert and Richter, *Ann.*, **446**, 155, 1925.

[4] Bhullar and Venkataraman, *J. Chem. Soc.*, **139**, 1165, 1931.

[5] Baker, *J. Chem. Soc.*, **143**, 1381, 1933.




(IX)

has been described by Cheema and Venkataraman[6], who isolated it from the products of the interaction of 2-benzylacetyl-1-naphthol (VIII), ethyl formate and sodium. On heating (VI) with acetic anhydride or alcoholic sulphuric acid 3-benzyl-α-naphthapyrone (IX) was obtained.

H. S. MAHAL.
K. VENKATARAMAN.

Forman Christian College,
Lahore,
*December 4, 1933.*

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## Cytoplasmic Inclusions in Acentrogobius Neilli (*Gobius neilli*. Day).

CYTOPLASMIC inclusions in Invertebrates have been worked out by a number of authors but workers on Vertebrate oogenesis seem to be few. Fish eggs have been studied by Hibbard and Parat, Eggert, Nath and a few others.

Acentrogobius neilli (*Gobius neilli*. Day), a common brackish water form in Madras, was studied by examination of fixed preparations as well as of fresh oocytes before and after treatment with solutions of neutral red, Janus Green.B, Scharlach.R, Sudan III and Osmic Acid 2%.

The mitochondria were studied from Champy, Bensley-Cowdry, Nassonov and Mann Kopsch preparations and for a study of the Golgi in addition to the last-mentioned technique Da Fano's silver impregnation method was also employed.

The mitochondria occur as a dense cloud of granules immediately surrounding the nucleus. With the growth of the oocyte they seem to move almost in the form of a ring away from the nucleus leaving a fairly clear space round the nucleus. They multiply quickly and soon occupy the whole area of the cytoplasm. They are not observed to take part in deutoplasmogenesis.

The Golgi apparatus occurs as an irregular mass just touching the nuclear membrane. This breaks up and moves into the surrounding cytoplasm in the form of granules. Later they seem to be associated with fatty yolk globules.


Mann Kopsch Allman.
Young Oocyte. ×325.
M.=Mitochondria.
F.=Fat.
NLEX.=Nucleolar Extrusions.

Fat and fatty yolk both occur in the egg. Fat seems to arise from nucleolar extrusions. Fatty yolk probably arises by condensation of material by the Golgi apparatus.

A perusal of the literature on cytoplasmic inclusions will show that the term *fatty yolk* has been used to mean both yolk with a large quantity of fatty or lipoidal material (Ludford) and also for fat not miscible with the general cytoplasm (Nath). Actually there appears to be more than two kinds of deutoplasmic inclusions *fat*, *fatty yolk*, and *yolk* in eggs and it is proposed to discuss this matter more fully in a future communication.

M. K. SUBRAMANIAM.
R. GOPALA AIYAR.

University Zoological
Laboratory,
Madras,
*December 1933.*

Hibbard, Hope and Parat, M., "Oogenesis of certain Teleosts," *Jour. Anat.*, **61**, 1927.

Eggert, Brune, "Entwicklung und Bau der Eier Von Salarius flavo-umbrinus Rupp," *Zool. Ann.*, Bd. **8**, 1929.

Nath, V. and Nangia, M. D., "A demonstration of the Golgi Apparatus and the vacuome as independent components in the fresh eggs of Teleostean Fishes," *Jour. Morph.*, **52**, 1931.

Nath, V., "Microchemical Tests: fats, lipods and vacuoles with special reference to Oogenesis," *Quart. Jour. Micr. Sci.*, June 1933.

Ludford, R. J., "Contributions to the Study of the Oogenesis of Patella," *Jour. Roy. Micr. Soc.*, 1921.

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[6] Cheema and Venkataraman, *J. Chem. Soc.*, **141**, 918, 1932.

### Electrical Resistance of Gel-forming Mixtures during Setting.

HURD AND SWANKER in a letter to the Editor (*Journ. American Chemical Society*, June, 1933), have reported that the electrical resistance of gel-forming mixtures containing solutions of sodium silicate and acetic acid of various concentrations, undergo no change during the process of setting.

Prasad and Hattiangadi (*Journ. Indian Chem. Soc.*, **6**, 893, 1929) had observed that the pH (determined colorimetrically) of the alkaline gel-forming mixtures containing sodium silicate and acetic acid increases during the process of gelation. With an expectation that some consequent changes in the electrical conductivity of the gel-forming mixtures would take place during the process of gelation we undertook to measure the electrical resistance of the gel-forming mixtures containing solutions of various concentrations of sodium silicate and of acetic and citric acids in February 1932. Our results were in agreement with those now reported by Hurd and Swanker that the electrical resistance of a gel-forming mixture does not change during gelation.

R. K. UPADHYA.
MATA PRASAD.

Royal Institute of Science,
Bombay,
*December 1933.*

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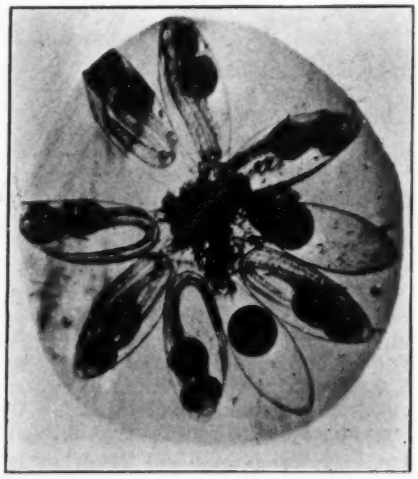
### Preliminary Observations on the Life History of Acentrogobius Neilli (*Gobius neilli*. Day).

SPECIES of Gobius are essentially shore forms and many are found in brackish and fresh waters. The eggs and life-histories of several forms of this genus have been described by Guitel, Holt, Petersen and Lebour, to mention a few. Their accounts mostly deal with the nature of the eggs and the time of their occurrence. *G. minutus*, *G. microps*, *G. pictus* and *G. ruthensparrii* have had their life histories more fully worked out by Lebour and Petersen. Gobius usually attaches the eggs to shells of Lamellibranchs such as Pecten, Ostrea, Mya, Cardium, and often to the shell of Patella. The breeding months near Plymouth seem to be April, May and June. Hatching takes place in about a fortnight and a free swimming larva about 3 mm. long without pelvic fins emerges. Very little is known about the life histories of the forms occurring in India. Several stages of *G. ostreicola* were described by Bhattacharya from preserved material from the Chilka Lake.

*Gobius neilli* occurs in large numbers in the brackish waters of Adyar and grows to 3¼ inches. They begin to breed when they are 20 mm. long. Mature females can be obtained in enormous numbers just before the monsoon. A few days after commencement of the monsoon most of them are found to have spawned. Developing stages were obtained by artificial fertilisation.

Almost immediately the outer cover of the egg swells up into a club-shaped structure. The micropyle comes to be placed at the



narrow end of the club through which mucilaginous threads flow out and anchor the egg case to the substratum. The case itself is packed with a jelly like material in the centre of which the embryo undergoes its development.

Within 32 hours after fertilisation the Head, Eye Vescicles, Notochord and Brain are established.

The embryo begins to rotate in a longitudinal axis in the egg case from the middle of the second day and hatches out as a free swimming fry at the beginning of the third day of development (72 hours). The process of hatching is interesting and is executed by the embryo breaking open one side of the egg case near the free end. Further development has been followed up to the eighth day.

The time taken for hatching is very much less in this form than in those described by Lebour and can only be attributed to the

smaller size of the eggs (0·4 mm.) in *G. neilli* and also to the great difference in temperature conditions being 14°C. near Plymouth and 25°C. in Madras. Orton and others have drawn attention to the effect of temperature on the breeding of several marine animals.

R. GOPALA AIYAR.

University Zoological
Laboratory,
Madras,
*December, 1933.*

Bhattacharya, D. R., "Stages in the Life History of Gobius, Petroscirtes and Hemirhamphus," *Mem. Ind. Mus.*, Chilka Lake, **5**, No. 4.

Guitel, F., "Observations sur les. Mœurs de Gobius minutus," *Arch. Zool. Paris*, **10**, 2, 8, 1892.

Holt, E. W. L. and Scott, S. D., "A record of the Teleostean eggs and larvæ observed at Plymouth in 1897," *Jour. Mar. Biol. Assn.*, N. S., **5**, 1897-99.

Lebour Marie, V., "The young of Gobiidæ, from the neighbourhood of Plymouth," *Jour. Mar. Biol. Assn.*, **12**, 1919-22.

Lebour Marie, V., "The eggs of Gobius minutus, pictus and microps," *Jour. Mar. Biol. Assn.*, **12**, 1919-22.

Peterson, C. G. J., "On the Eggs and Breeding of our Gobiidæ," *Rep. Danish Biol. Stat.*, **2**, 1891-92.

Orton, G. J. H., "Sea-Temperature, Breeding and Distribution in Marine Animals, *Jour. Mar. Biol. Assn.*, **12**, 1919-22.

## Research Notes.

### Intra-cellular Inclusions in Tobacco Ring-Spot.

THE list of plants affected by viruses or ultra-microscopic organisms is quite large extending to a large number of species. Of these, only in a few cases, the diseased cells are characterised by the occurrence of intra-cellular inclusions. The latest addition to this group is the ring-spot of tobacco which has been re-examined by Woods (*Contr. Boyce Thompson Inst.*, 5, 419, 1933), who has established the presence of such bodies in plants infected under green-house conditions. These are found to occur in all cases of primary lesions in the several varieties of tobacco studied. In the case of *N. tabacum*, however, they were present where the lesions were systemic. Ring-spot disease is also observed to affect *Petunia* sp. where a similar observation has been made.

The occurrence of these inclusion bodies has been investigated with particular reference to structure, position in the cells, and distribution in the affected leaves. The bodies are always found in association with the nucleus. Non-lesioned areas did not show any such body in them. In the lesioned spots, the cells in the central portion had a greater number of bodies than those in close proximity to the necrotic areas. In these cases, the cells appear to have undergone considerable disintegration. Where the bodies were present, the cells containing them did not show visible signs of degeneration. But the development of the bodies could directly be correlated with the formation of visibly lesioned areas in the leaf.

In an affected plant, the growing point and tender shoots, although they showed partial necrosis, did not contain the bodies. As a rule, the oldest and largest cells contained them. The occurrence of these is more easily traceable to the metabolic condition of the cell at the time of inoculation, rather than to the lapse of time during which the virus remains in the cell. The bodies were generally observed to be vacuolated. Besides the vacuoles, certain other inclusions were detected within the bodies chiefly, the red staining cuboidal bodies. From the manner of their occurrence in the cell cytoplasm also, the author imagines them to be protein crystals.

The state of aggregation of substances in the diseased cells, lend the view that these vacuolated inclusion bodies represent an accumulation of certain materials in the cytoplasm. In a few instances of primary lesions the bodies were noticed to have a membrane-like periphery. The appearances and staining reactions reveal a striking resemblance to masses of young cytoplasm.

The study is important from the point of view of the origin and development of the intra-cellular inclusion bodies characteristic of virus diseases of plants. V. I.

### Discovery Reports—Sponges.

IN the "Discovery Reports" (Vol. VI, pp. 239-392, plates xlviii-lvii, 1932) issued by the Discovery Committee, Colonial Office, London, Maurice Burton of the British Museum (Natural History) has given an exceedingly interesting account of the

Sponges collected during the years 1925-1929 by the R. R. S. 'Discovery' and the R.R.S. 'William Scoresby' in the course of their cruise in the South Atlantic Ocean, and by the staff of the Marine Biological Station at South Georgia. The collections include representatives of 168 species and varieties of which only 35 are new. The descriptive part of the account is preceded by a systematic list of the species under report and a list of the stations with the names of species collected at each. It is impossible within the short space of a review to refer to all the points of interest raised and discussed by the author, but the more important ones, such as the correlation between the distribution of Sponges and the main surface currents of the oceans, the embryonic development and its value in systematic study, and the significance of external form in the identification of Sponges, may be referred to in the briefest manner possible.

To the beginner in the systematic study of Sponges, confused by the bewildering multiplicity of genera and species based not infrequently on worthless characters, discernible only by their authors, the present report seems to hold out a promise that on a careful study of a large number of specimens of the various species from one or more localities, the number of the so-called genera and species will be reduced, in the not distant future, to an extent that will prove an inducement for more extended study of this group. The author's remarks in the systematic account under *Isodictya setifer* (Topsent), *Amphilectus fucorum* (Esper), *Iophon proximum* (Ridley), and *Tedania massa* (Ridley and Dendy) seem to justify this statement.

In the section on Geographical distribution the author dilates on the controversial but highly interesting hypothesis that despite the barriers set up by temperature the main oceanic currents act as the agents of distribution of Sponges, and that transportation by currents may possibly happen in the post-larval stages of some species, at any rate, when the young Sponges, in most cases, are in the form of thin incrustations on floating objects. The fact that some species of Sponges are common to both Australia and the West Indies, and to the west coast of Africa and the Indian Ocean seems to support this hypothesis. He then goes on to describe the two well-defined areas of distribution each with its distinctive fauna—the Indo-Pacific *cum* Indian Ocean, which he terms the Indian Ocean area, and the South Atlantic area including the portion below a line approximating to the equator, both with their practically closed systems of currents, and how at the meeting point of the warm Agulhas and the cold Benguela currents south of the Cape of Good Hope, and of the warm Brazilian and the cold Magellan currents on the South American coast at a line level with Beunos Aires, effective temperature barriers are formed which prevent a general mixing of the species in the two well-defined areas. While, as pointed out above, some species common in the Indian Ocean area are also found on the west African coast and in the West Indies, no species of the South Pacific area are found in the S. Atlantic beyond the Beunos Aires barrier. This fact shows that while in one case the temperature barrier is incomplete, in the other it is complete. In the author's opinion a more important deciding factor in the matter of distribution is the relation of the two currents which constitute the barrier, that is to say, whether the currents running in opposite directions do really oppose as in the case of the Beunos Aires barrier, or only run parallel to each other as in the Cape of Good Hope barrier. In the latter case the migration of species from the Indian Ocean area to the West Indies through the S. Atlantic along the west coast of S. Africa following the flow of the Benguela current, and thence into South Equatorial becomes intelligible. So far as the Sponge fauna of the S. American coast is known, no species south of the Beunos Aires barrier is found north of it. The author's explanation for the completeness of this barrier is both ingenious and plausible. "Since the currents are opposed, any mixing that may take place is nullified by the fact that the cold current from the south encounters and passes under the Brazilian current, continuing its journey northwards beneath the surface. In this way any floating bodies reaching the northern current will be restored once again to the warm surface waters of the South Atlantic." It is refreshing to note that the author has an open mind on the subject, and emphasises the need for a thorough test of his hypothesis by extensive observations in other parts of the world, not merely for Sponges, we hope, but for other groups of the marine fauna as well.

In the section on the embryonic development of Sponges the author points out the possible value of the embryos (at least in preserved material) to the systematist, and

proceeds to describe the embryos of some species of *Tedania* with clear sketches of all the stages found, and of several species belonging to various other genera. On pages 342-345 of the report this point is greatly elaborated in reference to the species of *Tedania* which amply justifies the author's faith in embryological data as the "deciding criterion in systematic work". It is to be hoped that the lead given by him in this respect will be followed by other workers on the group.

In another section of the report (pp. 375-378) the value of external form in the identification of Sponges is referred to, and the various criteria on which identification of Sponges is based are critically examined. According to the author, the most reliable guide for the diagnosis of families is the categories of spicules present, for that of genera, the arrangement of the various elements of the skeleton with minor variations in shape, and for that of species, the external form with minor variations in the arrangement and categories of spicules present. The role of environmental factors in determining the shape of a Sponge should not, however, be overlooked, and in the description of Sponges details of habitat and associations are a great help in judging the precise limits of a species. Much of the confusion in systematic Spongology can be avoided by careful and adequate descriptions of species from entire Sponges, with due attention given to the variation in the shape and size of spicule categories, and to the external form. The author's remarks on these points deserve a careful study.

H.S.R.

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### Secretion of the Pancreas and Salivary Glands.

E. S. DUTHIE (*Proc. Roy. Soc. Lon.*, **B. 114**, No. 786) has extensively examined the behaviour of the cytological constituents and their relation to secretory activity in pancreas and salivary glands. Confining his studies to the mouse and frog, the author determines the value of mitochondria and golgi in secretion in these two types of glands. In the pancreas observations on living cells by the intravitam method of staining have revealed the origin of the zymogen granules in relation to mitochondria. The migration of these granules towards the golgi area has been actually observed in living cells. Contrary to the views of Parat the vacuome has no relation to the golgi body. In the salivary glands the conclusions of the author have been largely deductive. The occurrence of the secretory granules at the base of the cells and away from the golgi area has led the author to think that the granules arise in relation to the mitochondria. The account mostly confirms the conclusions of Hirsch. Stimulation of cells is seen to produce fat granules in both kinds of cells, probably as a result of the disintegration of the mitochondria.

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### Rains of Fishes in India, with a Note on their Meteorological Aspects.

THE following is a summary of an interesting paper read by Dr. S. L. Hora before the ordinary monthly meeting of the Asiatic Society of Bengal held on the 4th December.

In the *Statesman* of the 14th of September, 'Kim' published a short note on three rains of fishes in the Muzaffarpore District. The information was supplied to him by an eye witness, Mr. G. T. Gill of the Bhicanpur Factory. Kim's note was followed up by the author with the result that a great deal of valuable information has been collected through Kim's numerous correspondents, some of whom supplied information direct to the author. Since the 15th of September the *Statesman* has been publishing accounts of rains of fishes from time to time and it would seem that the phenomenon is still regarded by the general public with scepticism and that any explanation showing fish falling from the sky is considered a myth.

The first two records of rains of fishes in India were published in 1833 in the *Journal of the Asiatic Society of Bengal* by James Prinsep, the celebrated Secretary of the Society, and upto the present time 10 instances had been recorded, the last being in 1852 at Poona. It is undoubtedly true that every fall of fishes that occurs is not recorded, but the phenomenon is sufficiently unusual and striking to have attracted the attention of a number of people. Kim's column in the *Statesman* has unearthed several such records which would have passed unnoticed otherwise. The author gives particulars of the Rains of Fishes hitherto recorded from India, including those that fell during this year, and mentions

the species of fish known to have fallen with rains in India. The kinds of fishes that rained in Muzaffarpore in July and August last will be exhibited and attention will be directed to their mode of life, etc.

Five explanations of the rains of fishes have been advanced, namely, (i) hatching out of eggs after heavy rainfall; (ii) fishes wrongly supposed to have fallen with rain might have been migrating overland from one stream or pond to another; (iii) fishes might have been left behind by overflows after heavy floods; (iv) fishes may have been æstivating and have been awakened by the coming of the rain; and lastly (v) the rains of fishes are due to the action of heavy winds, whirlwinds, and waterspouts. All these explanations are discussed by the author and it is indicated that the only explanation tenable is that of whirlwinds and waterspouts. The popular belief of the people of northern Behar regarding waterspouts is given, and in his note Dr. S. N. Sen, Meteorologist at the Alipore Observatory, has shown how waterspouts may be formed in India and by analyzing the meteorological conditions on the two days of occurrence of the rains of fishes in the Muzaffarpore District has shown that during those days the weather conditions were most favourable for the formations of waterspouts over that area. Several other meteorological problems regarding the falls of fishes in India are also discussed.

## The Theory and Practice of Drying.

UNDER the joint auspices of the South Indian Science Association, Bangalore, the Society of Biological Chemists, India and the Indian Chemical Society (Madras Branch), an interesting discussion on the "Theory and Practice of Drying" was held on Sunday, the 12th November 1933, in the Central College Chemistry Lecture Theatre, Professor H. E. Watson of the Indian Institute of Science, presiding.

In the course of his opening remarks, Dr. Watson drew attention to the great importance of drying in science and industry. In a tropical country such as India where plenty of sunshine was available, and industries were not highly developed, the problem had not received as much attention as it had in those places less favourably situated, since sun-drying sufficed for many purposes. This simple process, however, was apt to become impracticable when large quantities of material had to be handled and in many cases contamination by dust would render a product unmarketable. It was essential therefore to pay attention to more complicated methods.

Although the theory of drying was similar for all materials, in practice there were wide differences in the methods of treatment. In the first place the temperature to which the material might be subjected was of importance. At one end of the scale were found substances which might be raised to a red heat without deterioration and at the other those which had to be dried at a temperature not exceeding that of the body. A second consideration was the physical nature of the material. With goods such as textiles, the rate of drying depended almost entirely upon the quantity of hot air or other drying agent which could be supplied, while with clays diffusion in the material itself was the controlling factor. In addition to these general considerations a special technique was required in many cases and thus it was evident that the problem was one of great complexity.

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THEORY OF DRYING—I. *M. A. Govinda Rao.*—When solids of appreciable thickness are dried, the moisture must, by some mechanism or other, travel from the interior out to the surface before it can escape into the surrounding drying medium. This mechanism determines the particular variables which govern the rate of drying and the quality of the product.

Materials of fibrous or colloidal nature when brought into contact with air of definite temperature and humidity, will dry up only to a limiting moisture content, known as the "equilibrium moisture content" or 'regain'. It is just the moisture content in excess of this value that is capable of being removed by drying.

If we start with a wet solid, under steady drying conditions, the rate of drying at first remains constant and then falls off. The rate at which moisture can evaporate from a continuous film of water on the solid surface, determines the constant rate of drying, and to a certain extent also the rate during the initial stages of the falling-rate period, until the surface of the solid reaches the equilibrium moisture content. Thereafter the velocity with which water can diffuse outwards from the interior of the solid, determines the drying; the rate of diffusion, and hence of drying, falls off with decreasing average moisture content, or in other words, with decreasing average concentration difference through the solid. During this diffusional stage in drying, neither decreasing the humidity of the drying medium, nor increasing its velocity, will speed up the drying process. T. K. Sherwood (*Trans. Amer. Inst. Chem. Eng.*, **27**, 90, 1931) and A. B. Newman (*Ibid.*, **27**, 203, 310, 1931) have developed equations for calculating the rates of drying for different solid shapes and have represented them in the form of simple curves.

When a wet solid is drying at constant rate, moisture gradients are set up in the interior of the solid. The magnitude of these gradients is of immense importance in the drying of materials which tend to warp or crack. A differential moisture content in the body of the solid causes a differential shrinkage, which must be prevented from becoming dangerously large. E. R. Gilliland

and T. K. Sherwood (*Ind. Eng. Chem.*, **25**, 1134, 1933) have very recently developed equations from which the true moisture distribution inside a slab can be computed at different intervals of drying at a constant rate.

Although all the equations that have been derived are in fairly close agreement with experimental data, the actual mechanism by which the water travels up to the surface is not still properly understood. In several cases the water may evaporate before it reaches the surface; how this factor influences the moisture distribution is a problem requiring further elucidation.

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THEORY OF DRYING—II. *K. R. Krishnaswami.*—Careful control is essential in the drying of crystalline materials with a view to prevent loss of water of crystallisation. Drying in absence of air with the aid of superheated steam, is a process of great utility in dealing with certain classes of substances.

The period necessary for the operation of drying depends upon the area of surface exposed and wherever possible, attempts are made to reduce the material to a fine state of subdivision; where however such reduction in size is not permissible, the drying would be an extremely slow process. Attempts to speed up the process will only result in unequal drying which leads to the production of unsuitable articles; such instances are to be particularly found in the glass and ceramic industries.

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INDUSTRIAL DRYING EQUIPMENT—I. *S. K. Kulkarni Jalkar.*—Sticky and plastic substances, pastes and precipitates are dried in compartment driers provided with devices for circulating hot air over and between the trays containing the material. Substances which are sensitive to heat are treated in a vacuum compartment drier, the material being spread in thin layers on the heated shelves. Tunnel driers are employed when large quantities of materials have to be dried, the material being conveyed on cars continuously with counter current circulation of hot air.

Granular and crystalline materials are dried in rotary driers. The material is fed at the high end of a cylindrical shell directly or indirectly heated with its axis set at an angle to the horizontal and mounted on rollers. The rotation of the drier and the internal flights advance the material to the lower end in showers which meet the counter-current hot air. Sticky materials are handled in mechanically agitated driers of either atmospheric or vacuum type.

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INDUSTRIAL DRYING EQUIPMENT—II. *L. Gopala Rao.*—The simplest form of dryer, whose field of application is however limited, consists of a series of travelling endless belts, on to which the material is suitably fed and dried by passing dry, hot air in counter-current. The use of this dryer for drying chilled soap direct from the kettle has resulted in eliminating the tedious intermediate operations of cooling in moulds, slabbing, cutting and chipping and, particularly, reduced the time from several days to fifteen minutes. Where the material is sensitive to heat, the dryer is enclosed in a special vacuum chamber and the bands slide over steam or water-heated plates which supply the necessary heat.

A common device applicable to various products is the drum dryer. A slowly revolving steam-heated drum dips into a shallow pan or tray (or meets a uniform spray of material) and the resulting thin film is evaporated to dryness in about three-quarters of a revolution and loosened from the drum by adjustable scrapers. Elaborate precautions have to be taken to ensure that a satisfactory film is formed and the scrapers bear on the drum with proper pressure and at an optimum angle. The condensate and non-condensible gases must be removed from the interior of the drum with great promptness, as it is known that the presence of 0.5% of non-condensible gases reduces the coefficient of heat transfer by 50%. For dealing with sensitive materials like milk a vacuum drum dryer has been popular, particularly in America. Apart from the enormous expense and the trouble in discharging the solid product against the vacuum in the dryer, the product is, as a rule, unsatisfactory. Thus it is impossible to produce a reversible milk powder because of the over-heating of the film in contact with the steam heated surface. Steam at sub-atmospheric pressure is sometimes employed for heating, but the consequent low temperature gradient results in incomplete desiccation, and the keeping qualities of the powder are thereby impaired.

The most attractive proposition for sensitive organic substances is spray drying which, although comparatively recent, has displaced the vacuum drum dryer for many purposes. The range of application is unusually wide insomuch as, besides a variety of fluid and semi-fluid inorganic, organic and biological substances, solid precipitates in suspension, such as dye-stuffs, can be satisfactorily handled and a dry powder of uniform particle size produced thereby eliminating the subsequent operations of grinding and sieving. A spray of the material is brought into contact with dry, hot air and as a result of the enormous surface exposed (about 10,000 sq. ft. per gallon), drying is almost instantaneous and the product is collected in bag filters. The adiabatic cooling of the air ensures a very low temperature (about 40°C.) of the particles being dried. Although the average temperature of the drying chamber is appreciably higher, the product is subjected to this temperature only when it is dry and comparatively stable towards heat. Thus egg albumen which coagulates at 60°C. can be spray-dried to a reversible powder with hot air at 100°C. or more. In fact recent practice tends to employ gases at 400-500°C. when dealing with sensitive organic substances.

Hitherto spray drying was considered suitable only for expensive products; but in view of recent developments in industrial process equipment, it would appear practicable to adapt the process to cheaper substances like sugar, and an attempt in this direction is being made by the author. Complicated rotary spraying devices, consisting of discs of special design rotating at ten to twenty thousand revolutions per minute, can be substituted in many cases by cheap modern spray nozzles. Revolutionary designs of dual dust-collecting-and-exhausting fans are available, which would make it feasible to eliminate the customary bulky and expensive bag filters. The

drawback of a low thermal efficiency, which is the principal objection against spray drying, can be readily overcome by using products of gaseous combustion, or even exhaust gases from suction gas engines, in place of drying air. Spray drying would then simplify itself into a cheap, rapid and easily operated process suited to common industrial requirements.

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BIOLOGICAL MATERIALS.—I. *M. Sreenivasaya.*—Most of the biological materials are hydrophillic colloids and contain thermo-labile constituents, often sensitive to changes in hydrogen-ion concentration, contamination with heavy metals like lead and copper and atmospheric oxygen. Enzymes, vitamin concentrates, harmones, anti-toxins and therapeutic sera, large quantities of which are now being prepared, come under this category. They are usually associated with other relatively inert bodies which have the characteristics of a true colloid.

These products require to be desiccated under conditions least harmful to the essential constituent or the active principle and the operation should be speeded up since the materials are liable to microbial infection in the wet condition. The colloidality renders the diffusion of water through the gel to the evaporating surface slow and the crust formation hinders further evaporation.

In the preparation of most enzyme preparations, treatment with absolute acetone offers a very convenient and rapid method. For example, yeast zymase or Taka-diastase fungus powder is prepared in this manner. When all the constituents are desired the solvent method is unsuitable; film or spray drying is then usually employed.

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BIOLOGICAL MATERIALS.—II. *Gilbert J. Fowler.*—The drying of *Activated Sludge* involves a number of special considerations. Well "conditioned" activated sludge consists mainly of zoogloeal masses of bacteria and other micro-organisms. In bulk it is a gelatinous mass which holds a critical percentage of water very tenaciously. Percentages above 80 per cent. or so can be readily drained off, the remainder constitutes the problem. Left to air dry at temperatures below say 70°F., the drained sludge remains more or less indefinitely as a putty-like mass, if indeed it does not decompose and become offensive.

If dried in thick layers at tropical sun temperature, it is converted into horny lumps difficult to powder.

The method adopted at Milwaukee, where large-scale drying has been undertaken is to drain off the "excess" water on Oilver Filters, and dry the residue with its 80 per cent. moisture at a high temperature in rotary driers. By such a method there is likelihood of loss of nitrogen through driving off of volatile products, and of rendering the remaining percentage less "available" for plant food than is the undried product. Moreover the whole of the 80 per cent. moisture has to be evaporated.

The Fowler Drying Mat, specially devised for the drying of activated sludge, and for which a Patent has been granted in the U.S.A., seeks to avoid these disadvantages.

By employing a surface of stiff parallel vertical fibres on which the colloidal jelly rests (an endless moving band of specially compact coir mat, in fact), the excess water is rapidly drawn away from the film of jelly. When hot air is passed over this thickened jelly as it rests on the mat, the jelly "cracks", and the "bound" water is released and runs away between the fibres of the mat, leaving a thin dry sheet of sludge on the mat, which can easily be brushed off as the mat rotates, and the fibres open at the turn of the mat.

Successful preliminary trials have been made at Cawnpore and Nagpur, and a model is now under observation at the Ishapore Rifle Factory near Calcutta.

The Cawnpore experiments showed that with a film of sludge not exceeding 1/8 inch in thickness, and hot air at a temperature approaching 200°C., the jelly could be dried in about a quarter of an hour.

An air temperature of 200°C. does not mean that the mat reaches that temperature. It is constantly moist with the water percolating from the "cracking" jelly, and the brown paper like film of sludge prevents rapid conduction of heat. It has been found advisable to oil the fibres of the mat in order to prevent adherence of the sludge and penetration of soluble salts into the fibres.

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DRYING OF FOODS AND CONDIMENTS.—*B. N. Banerjee.*—The water content of any food material determines its perishability or keeping quality: cereals, grams and pulses and nuts are non-perishable; less juicy fruits and vegetables like potatoes, carrots, apples and pears are semi-perishable; and juicy fruits and vegetables and other products like milk or eggs are perishable. The practice of dehydration is to prevent perishability and help in the storage of foods and condiments. Dewatering is carried to an extent and in a way, so that the taste, flavour and nutritional value are not lost or impaired and keeping quality ensured. The dried product weighs only a fraction of the original weight and a great saving is assured in packing, labour and transport. The entire product is easily rendered edible on re-hydration.

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SUGAR INDUSTRY.—*G. Gundu Rao.*—Drying in sugar industry which forms generally the very last stage is usually accompanied in the centrifugals where large volumes of air incidentally drawn effect a partial desiccation of the sugar crystals. This process is aided by raising the temperature of the baskets by means of steam.

To secure a more complete drying, the product is carried to an upper floor of the factory and fed into the hopper of a long inclined drum rotating on its longitudinal axis, once in about six minutes. In the interior of the drum and attached to its wall are vanes whose free edges are cut into teeth like those of a saw. A counter-current of hot air (180°F.) blown from the opposite end effects the drying of sugar in about 20 minutes. There are several modifications of such driers. Recently, the Jenkin's vertical type of drier is coming into favour. The chief feature of this type is a central rotating shaft carrying trays along its length. Sugar is fed into the topmost tray and is then thrown down from tray to tray as the shaft rotates. The sugar crystals have a chance of being exposed to the upward stream of hot air for the maximum length of time and the possibility of incrustation is thereby reduced.

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DRYING IN PAINTS AND PIGMENTS. *S. K. Datar.*—Pigments required for paint manufacture are either obtained from natural sources or prepared by precipitation. Natural pigments require powdering or levigating or both before they can be utilised. There are machines to powder coarse pigments dry in one operation to 300-400 mesh; in other cases the pigments are levigated in water. Both levigated and the artificially precipitated pigments which have a varying water content of 20-50 per cent. require to be thoroughly dried before they can be incorporated in the paints.

Their water content can be reduced to a certain extent by filter pressing at high pressures, but for preparing them in a dry condition they require further treatment. A simple way of drying is to leave the pigment in trays in thin layers on racks for days, exposed to air, but this or even the sun drying are slow processes and are subjected to contamination by gritty particles and dust. A quicker way is to dry in suitably constructed chambers heated by fire, steam or electricity. In the case of white lead simple open air drying is extremely slow and involves the risk of contamination by dust and discolouration. Drying in a chamber heated by flue gases has been found to be uneconomical.

By replacing water in filter-pressed white lead with linseed oil, the process of drying can be completely eliminated. The old way of preparing the paint was to mix previously dried and powdered white lead with oil in a pugmill. The modified process, in which the white lead from the filter press containing about 25 per cent. water, is directly pugged with linseed oil, has proved successful as the white lead has an affinity for oil in preference to water which readily separates.

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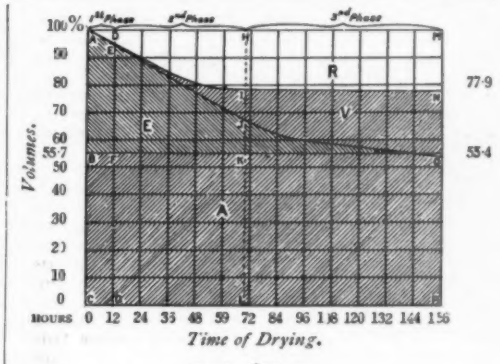
CERAMICS.—*N. V. Raghunath.*—Wet process, Dry process and Casting process are three methods of manufacture of porcelain.

The prepared body material employed in the wet process contains 25 per cent. of moisture. As soon as the articles are shaped in Plaster-of-Paris moulds constituting the moulding material to absorb water thus leading to a shrinkage in volume of the article. The greatest care has to be taken to see that the articles do not crack while in the moulds. A high humidity of the surrounding atmosphere ensures favourable conditions for drying and prevents "case hardening".

In the first stage (see figure) the shrinkage is proportional to the amount of moisture driven out. In the second, shrinkage and pores occur as well as the driving out of a certain amount of moisture. In the third stage, there is no shrinkage but only loss of water and the formation of more pores.

The chemically combined water is driven out at a higher temperature and at 500°C. it is completely driven out. The chemically combined water is driven out in kilns which are fired by coal, gas, electricity or wood.




**Drying Chart.**

R.=Shrinkage. E.=Water. V.=Pores. A.=Clay.

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DRYING OF TIMBER.—*C. Varadhan.*—The chief objects of drying timber are to reduce its weight, to increase its strength, to prevent decay and to minimise changes in its dimensions, after it is made up into furniture, etc. The moisture in wood is of two kinds, free moisture contained in the cells and hygroscopic moisture absorbed by the cell walls. The problem in all processes of drying timber is to remove all the free water, without producing case-hardening, unequal shrinkages and other defects which ultimately result in cracking and splitting of the wood. Modern methods of kiln-drying in which the wood is stacked in kilns, consist of drying by properly conditioned air. The heating is done by steam pipes, the humidity controlled by steam or water sprays and the circulation effected by convection currents or forced draught. The actual temperature, humidity and other working conditions depend on the particular species of wood. Among other methods of seasoning are the old haphazard one of seasoning in the open air, soaking in water followed by air-drying and the electrical methods.

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Messrs. B. Sanjiva Rao and K. L. Ramaswami in presenting laboratory aspects of drying, dealt with the relative efficiency of several desiccating agents. Mr. Krishna drew attention to the importance of drying in the pharmaceutical industries where preservation of the potency of drugs like digitalis is greatly influenced by variations in moisture content.

A detailed discussion followed under various aspects of the problem.

# Preparation of Fine Chemicals.*

By B. H. Iyer, M.Sc., A.I.I.Sc.

WITH the development of chemical industry in an organised form from the middle of the 19th century, the entire chemicals have been classified into two main divisions, *viz.*, Heavy Chemicals and Fine Chemicals. Mineral acids like sulphuric, hydrochloric, nitric and phosphoric, caustic alkalies of soda and potash, their carbonates and bicarbonates and many of the inorganic salts manufactured on a tonnage basis belong to the class of Heavy Chemicals. Analytical, pharmaceutical, photographic and rare earth chemicals, synthetic essences and perfumes, synthetic dyestuffs and research chemicals are considered as Fine Chemicals. As the organic compounds constitute a major portion of this class of substances, the progress of fine chemical industry has been intimately connected with the successful utilisation of the petroleum and coal-tar products—the two chief sources of organic compounds. For nearly half a century ending with the commencement of the Great World War in 1914, Germany was holding the sole monopoly for all fine chemicals. The War having shown the need for self-sufficiency, Great Britain and America mustered up their energies and creditably built up their respective national fine chemical industries. The humble but successful efforts to prepare the necessary research chemicals made by Prof. C. G. Derick of the University of Illinois in 1916 and ably continued by Prof. Roger Adams and others, brought into existence, the valuable 'Department of Synthetic Chemistry' of the Eastman Kodak Company, Rochester. While nations all around have been developing this very necessary branch of chemical industry, India has been depending on foreign countries for her needs.

The various processes employed in the preparation of these substances, may be divided into three groups:
(1) Inorganic Chemicals, (2) Organic Chemicals, and (3) Chemicals prepared by the action of biological agents. Inorganic chemicals are smaller in number than the organic compounds. Inorganic reactions are comparatively simple and the yields therefrom are better than in organic reactions. In the organic field, the process is hindered by the formation of more products than one, due to side reactions. The factors which decide the production of a desired product in good yield are temperature, pressure, concentration and the agent used for bringing about the reaction. Catalytic oxidation and reduction play an important part in synthetic chemistry. Employment of high temperature and pressure has enabled chemists to conveniently prepare very many of the compounds which could be obtained only in small quantities with great difficulty, before. Soda-water bottles lodged in iron frames and provided with rubber washers pressed in position by a screw arrangement, offer a convenient method of carrying out reaction under pressure. The insertion of a capillary tube in the cork used for sealing facilitates release of pressure, if present, at the end of the reaction. The process of fermentation by fungi, moulds or bacteria is revolutionising some of the synthetic methods. Although intensive research has enabled chemists to synthesise many of the natural products, their methods are entirely different from those adapted by Nature which does not involve the employment of such high or low temperatures or pressures or such strong acidic or alkaline media which are proved necessary for the manufacturing processes. Biochemistry would do a real service when it explores the subtle secrets of Nature and enables scientists to copy *in toto* the natural methods in the synthetic experiments.

The spread of civilization and the progress of research in this country demand an early establishment of a fine chemical industry in India. Although there are no separate statistical import figures, the knowledge that on an average 474 lakhs of rupees worth of chemicals, drugs and medicines and another 390 lakhs of rupees worth of dyes and colours are imported annually into British India, ought to be sufficient to set the industrial mind thinking as to what should be done.

In August 1930 a Preparation Section attached to the Department of Organic Chemistry, Indian Institute of Science, Bangalore, was started, for the first time in India, due to the efforts of Dr. P. C. Guha. This Section prepares almost all organic research chemicals necessary for work in the laboratories. Within these three years, more than a hundred different chemicals have been prepared in considerable quantities. This enterprise has proved useful in making special chemicals of requisite purity immediately available for research at low cost. Most of the chemicals costing more than Rs. 15 per kilogramme have, in fact, been prepared with a large margin of profit. The Section has proved useful in imparting valuable training in preparative chemistry to post-graduate research students.

*Abstracted from a lecture given under the auspices of the South Indian Science Association, Bangalore, on 24th November 1933.

## Science News.

*All-India Medical Licentiates' Conference.*—The twenty-sixth session of the conference will be held at Bombay during the last week of December. The Bombay Branch of the All-India Medical Licentiate Association has organised a sanitary and scientific exhibition for the occasion.

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Under the auspices of the Association of Economic Biologists, Coimbatore, a meeting was held on the 24th November, when two papers (1) The Problem of Selection in Hybrid Progenies—by V. R. Ayyar, (2) Some aspects of the drought resistance with special reference to cotton—by R. Sankaran, were read and discussed. In the course of his address on the Problem of Selection, Mr. V. R. Ayyar pointed out that the adoption of either the Mendelian or the Svalof method has neither completely eliminated the element of uncertainty in alighting on promising lines, nor reduced to its minimum, the time factor involved in the production of useful strains. Much improvement does not seem to be feasible in the Svalof method ; while the usefulness of the Mendelian method can be enhanced by carrying out the rejection of poor yielders except in cases of structurally sterile plants, by their comparative performances in the F. 3 generation raised in rows of suitable length and alternated with the standards.

In dealing with drought resistance of plants, Mr. Sankaran drew attention to the need for a close study of the morphological, anatomical and physiological organisation of the plant body for understanding the problem. The results obtained from a study of these factors in two varieties of cotton—Gossipium *herbaceum* and Gossipium *indicum*, were discussed.

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*Agricultural Research.*—At its meeting held in Delhi during the last week of November the Governing Body of the Imperial Council of Agricultural Research discussed several important agricultural research schemes. Among the schemes sanctioned, are (1) research on rural pisciculture from Madras ; (2) research on economics of irrigation from tube wells from the Bihar and Orissa Government ; (3) research on animal nutrition to be carried on at the Imperial Institute of Animal Husbandry and Dairying at Bangalore, the Agricultural College at Lyallpur and at the Indian Institute of Science, Bangalore ; (4) research in vegetable oil technology to be carried out at the Harcourt Butler Technological Institute, Cawnpore. The Governing Body also decided to set up an Indian Sugar Trade Information Service and to establish a number of fellowships for scientific research in Agriculture and Animal Husbandry, and to invite donations and subscriptions from the general public for this purpose.

* * *

*Patna Science College Philosophical Society.*—The annual report for the session 1932-33, which has been recently published shows that during the past three years of its existence the Society has done considerable useful work, firstly by holding periodical meetings of the members for discussion of scientific subjects and secondly, by arranging popular lectures for the benefit of the public. The Society publishes an annual bulletin and the present number extends over 63 pages and comprises 7 original papers.

* * *

*Indian Institute for Medical Research.*—A scheme for the establishment of an Indian Institute for Medical Research for investigating problems of medical science and "to train a band of research workers to apply the knowledge obtained to clinical practice and to preventive medicine and to disseminate the knowledge of hygiene among the masses, making its services available to them either free or at a low cost." The Institute will comprise of six departments, Bacteriology and Pathology, Tuberculosis, Biochemistry and Nutrition, Protozoology, Experimental Pharmacology and indigenous drugs enquiry and Diagnostic Laboratory and Clinical Work. The initial expenses for starting such an Institute will be Rs. 1,25,000 and the recurring expenditure will be 1,10,000 annually. The sponsors of the scheme consisting of eminent men of the country have appealed to the generosity of the public for the initial expenditure necessary to establish the Institute and to enable it to function for the first year, namely, the sum of Rs. 1,25,000. It is hoped that the Institute will be self-supporting after the first year.

* * *

The 21st Session of the Indian Science Congress will be held at *Bombay* and not at Poona as previously announced, between the 2nd and 8th January 1934. Prof. Meghnad Saha, D.Sc., F.R.S., will preside over the deliberations.

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The Ninth Session of the Philosophical Congress which was previously announced to be held at Poona during the last week of December, has been postponed to Easter, 1934. The exact dates will be announced later.

* * *

*Technological Education in Bombay.*—A new University Department of Chemical Technology was recently inaugurated by His Excellency Sir Frederick Sykes and the Department is temporarily housed in the Royal Institute of Science. The need for adequate technological education in the Presidency was being felt for some time past and as a result of the deliberations of expert committees who investigated the question in all its aspects, a practical Scheme has now been evolved which ensures instruction on thoroughly practical lines, turning out experts with training and experience who can be of real assistance to the various industries of the country. The new department is completely self-contained and serves not only to impart instruction and training, but also provides facilities for research in Chemistry and Chemical Engineering. The University has already received donations to the extent of 2 lakhs of Rupees from the discerning public and industrialists of Bombay, and it is hoped that more financial help would be forthcoming which would make the extension of the present Department possible.

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*Agricultural Institute for Rajshahi.*—A scheme for starting an Institute for imparting training in Agriculture, has been formulated, following a

Conference between representatives of the Government and the executors of the endowment made by the late Kumar Basanta Kumar Roy of Dighapatia. The training will include both practical and theoretical aspects of Agriculture, and will be a two-year course. The recurring costs will be met from the interest which amounts to about Rs. 16,000 per year.

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*Nobel Prize in Medicine for 1933.*—It is understood that Prof. Thomas Hunt Morgan, For. Mem. R.S., of the California Institute of Technology, has been awarded the Nobel Prize for 1933 in recognition of the importance of his investigation on Heredity for the advancement of medicine.

* * *

*Journal of the Annamalai University.*—We acknowledge with thanks the receipt of the *Journal of the Annamalai University* (Vol. II, No. 2) published by the University. The Journal includes original contributions not only on subjects connected with experimental sciences but also with humanistic sciences and Tamil and Sanskrit literature. It would appear preferable to separate the various subjects, and publish them as separate parts. We congratulate the Board of Editors on the excellent get-up of the Journal.

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The next session of the All-India Economic Conference will be held at Annamalainagar under the auspices of the Annamalai University on the 2nd January 1934. His Excellency the Governor of Madras has graciously consented to open the session.

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*Universities Conference.*—The quinquennial Universities Conference will be held at Delhi on the 6th, 7th and 8th March 1934, under the auspices of the Inter-University Board. One of the important subjects that will come up for discussion before the Board concerns Technological Education in India. Sir C. V. Raman, F.R.S., N.L., Director, Indian Institute of Science, Bangalore, has been deputed by the Institute Council to attend the Conference.

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*Sugar Research in India.*—Following a meeting of the Sugar Committee at Coimbatore on the 15th of November, proposals were formulated for the establishment of a Sugar Research Institute under the control of the Imperial Council of Agricultural Research. The proposed Institute will be provided with facilities for carrying out research on sugar in all its aspects and the Coimbatore Sugar Station will be made a part of this central Institute, which will also be linked up with Harcourt Butler Institute in Cawnpore. More details about the Coimbatore Conference appear elsewhere in this issue.

* * *

*New Carl Zeiss Apparatuses for Microscopists.*—We have received from the local Sole Agents of Messrs.Carl Zeiss, literatures concerning three new and important introductions by them in Microscopy which appear to us to be of interest to our readers. Firstly, a new design in microscope has been evolved in the series L, H & V. The chief features in all these consist in securing a sensitivity in the slow motion, hitherto unachieved, *viz.*, of 1/1000th of a mm. per each interval of the drum-head. Another factor that makes for great facility in working the hands is that both the rough and slow motion drum-heads have been placed near the bottom of the stand, while other features vary in the three individual types. Next a new series of Epicondensers with illuminating systems have been brought forward which enable microscopic observations of surfaces and layers underneath without any need for microtome sectioning or staining. Under this system of illumination the microscopic structures are seen in their natural setting and colour somewhat as under a semi-dark-field illumination. Thirdly, the Mikro-Polychromar attachment has been designed to produce two systems of coloured beams of rays so that any preparation or object is illuminated by two systems of coloured beams, one along the path of the optical line of sight and the other which crosses it nearly at right angles. The different structures of the object produce a magnificent contrast, for example the cell wall and objects of colloidal dimensions scatter one kind of colour while the protoplasm or cell contents transmit another colour. We are sure the new series of microscopes and the two new types of illuminating mechanisms will be welcome to all microscopists.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3337 to 3340.

"The Chemical Age," Vol. 29, Nos. 746 to 749.

"Canadian Journal of Research," Vol. 9, No. 3.

"The Journal of Chemical Physics," Vol. I, No. 10.

"The Biochemical Journal," Vol. 27, No. 4.

"Berichte der Deutschen Chemischen Gesellschaft," 66 Jahrg, No. 10.

"Natural History," Vol. 33, No. 6.

"Journal of Agricultural Research," Vol. 47, No. 5.

"American Journal of Botany," Vol. 20, No. 8.

"Journal de Chemie Physique," Tome 30, No. 8.

"The Journal of Nutrition," Vol. 6, No. 5.

"The Review of Scientific Instruments," Vol. 4, No. 10.

"Medico-Surgical Suggestions," Vol. 2, No. 10.

"Journal of the Russian Chemical Society," LXV, Tome III, Livres 4 & 5.

"The Indian Journal of Medical Research," Vol. 21, No. 2.

"Indian Forest Records," Vol. 19, part 3; Vol. 15, part 8; Vol. 18, part 11.

"Dominion of Canada, Department of Agriculture" Pamphlet, Nos. 146, 147, 150, 157, 159, 160, 161, 165.

Report of the Minister of Agriculture for the Dominion of Canada, ending March 1932.

## Reviews.

PHYSICAL MECHANICS: An Intermediate Text for Students of the Physical Sciences. By Robert Bruce Lindsay, PH.D., Associate Professor of Theoretical Physics in Brown University. Pp. x+436. (London: Chapman and Hall, Ltd., 1933. Price 21*s.* net.)

This is a book quite out of the ordinary. The author has made a very definite and successful attempt to break away from the traditional method of presenting mechanics and the result is a thoroughly modern book which will very well fit the student, who uses it as a Text-book, to enter, later on, into the enchanting domain of modern Theoretical Physics.

The book is described as an intermediate text for students of the physical sciences, but, the fact is that the book can be recommended as an exceptionally well-written introduction to mechanics suitable for students of mathematics as well as of the physical sciences. The author maintains throughout a satisfactory balance between the physical and mathematical aspects of the subject, between general principles on the one side and applications to physics on the other. It can safely be recommended as an ideal book for study by mathematics and physics Honours students of the Indian Universities in the penultimate year of the Honours course.

No work on mechanics can be regarded as fully adequate that shuns the use of vectors where they undoubtedly contribute to clarity and simplicity. In the present case they are used judiciously appearing here and there throughout the work. Some important features of the work which distinguish it from the ordinary text-books on mechanics will now be noticed.

The treatment in Chapter I of mass and force and the laws of motion is quite rigorous and the early introduction of the mechanical principle of relativity is very satisfactory. The electron motions in the Bohr model of the H-atom and the $\alpha$-particle deflection as examples of motion in central fields of force are extremely well done. Chapter IV contains an elementary theory of the gravitational potential and Gauss' law of normal force, Laplace's and Poisson's equations are all derived in a simple and direct manner. The motion of a rigid body about a point is particularly well handled in Chapter VII by the use of the vector notation. One would, however, have liked to see the bracket notation for vector and scalar products replace the product notation used in the book. An innovation introduced in Chapter VIII is Gauss' principle of least constraint and the author has been very successful in the logical presentation of the topic. The chapter bearing the heading "Oscillations" includes a study of the simple harmonic oscillator in atomic theory. Chapter X is by far the finest in the book, and deals with the motion of a system of particles. A beautiful introduction is given to the elements of the kinetic theory of gases. The notion of generalised co-ordinates, Lagrange's equations and Hamilton's principle are all introduced in their appropriate places. Excellent as this chapter is, it could have been made more complete by introducing, in the body of the book, the canonical equations of motion and the Hamilton-Jacobi differential equation. Chapter XI is devoted in part to wave motion under which category several diverse types are studied. This chapter also contains the outlines of the elements of the theory of elasticity and is that portion of the book, which, according to the author, has an "engineering slant". But what little is given of this topic is, however, very well done. At the end of the chapter is given a survey of the wave mechanics of DeBroglie and Schrödinger. While it is possible that there can be two opinions regarding the wisdom or utility of introducing this subject in a book of this nature, there can be no question as to the extremely clear and simple presentation of the topic by the author. In Chapter XII a welcome addition to the usual topics dealt with under hydrostatics and hydrodynamics and a feature illustrating the modern nature of the book are the articles treating of viscous fluids, surface phenomena like capillarity and adsorption.

The book is remarkably free from misprints and there are no serious errors. The reviewer would recommend the deletion of Ex. 1, p. 47, and Ex. 1, p. 313, as being rather crude. Another notable feature is the decimal classification of the articles which enables the author to arrange the formulæ with ease. The book is very well produced as, it must be admitted, its price demands.

B. S. M.

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HIGH FREQUENCY MEASUREMENTS. By August Hund. First Edition. Pages xi+491. (Published by McGraw Hill Book Company, Inc. New York and London. 1933.)

To those who are acquainted with Dr. Hund's "Hochfrequenmesstechnick" this present work will be a welcome addition as an important and useful contribution to the literature on the ever-widening field of high frequency measurements. In the range of the subjects dealt with and in the treatment given to each, this ably-written book is a very comprehensive and up-to-date treatise.

The most valuable feature of the book is that the subject is dealt with in no narrow or mechanical manner; at every stage the discussion takes into its sweep inter-relations with allied subjects and thus helps at obtaining a correct and comprehensive perspective.

In the measurement of the different quantities, such as frequency, current, resistance, inductance, etc., the choice of method in relation to the magnitude is given careful examination. Wherever practicable, the constants in a formula are evaluated for ready use. In some cases worked examples are given for purposes of illustration in addition to indication in small type of experimental procedure.

Considerable space has rightly been devoted to the cathode ray oscillograph, its construction, performance and use for a variety of high frequency measurements. Its applications are increasing so rapidly, that it has very nearly become an indispensable instrument. The inclusion of a brief chapter on wave propagation measurements is proof of the increasing interest in the subject. Special measurements such as those of reflection coefficients, critical frequencies, etc., are not yet in such a stage of development as to be considered in a book of this type at present.

The simplest type of high frequency measurement involves some familiarity with the theory of the electro-magnetic field and the electron theory of matter on the one hand and fairly detailed knowledge of continuous and alternating current technology on the other. A brief discussion of the two would therefore have been a suitable beginning for the book. Circuit analysis properly takes the next place.

The question of standards does not appear to obtain the emphasis that is due to it. There is no mention, for example, of the tuning fork as a standard of reference, although it is so used in a number of countries. Measurement on triode oscillators find no place in the book.

The use of small print may be justified to some extent as a means of indicating matter, which, though not strictly part of the main text, is helpful to the understanding of the subject. But the diagrams and curves and particularly the explanatory letters and words in them are so small in size as to tax the eyes of any normal reader. There can be no doubt that with bigger diagrams and the avoidance of small print, the book would undergo a substantial increase in its size. But that is of secondary importance.

Apart from a few errors in the names of scientists such as "K. Omnes" on page 262 in place of "H. K. Onnes" and "G. Gonbau" on page 411 instead of "G. Goubau", the text appears to be free from errors.

Altogether a very fine and useful work.

R. E.

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WIRELESS RECEIVERS. By C. W. Oatley. Pp. 103. (Published by Methuen & Co., Ltd., London. 2*s*. 6*d*. net.)

With the remarkable spread of radio broadcasting and of the growth of short and long distance commercial radio telegraph and telephone systems the world over, the problem of reception methods and apparatus have increased enormously in volume and complexity. No book of the size under review can possibly attempt any worth-while treatment of the subject.

Mr. Oatley presents in this little volume of 100 pages a brief but clear treatment of the essential principles underlying the working of the different parts of a radio receiver, with special reference to distortionless broadcast reception.

Starting with the basic ideas of a modulated wave and of the different types of distortion in a receiver, the author deals with the essential characteristics of a triode. It is probably more usual to use slope conductance $\frac{\delta i_a}{\delta e_a}$ than its inverse, as the former accords with the mutual conductance $\frac{\delta i_a}{\delta e_g}$. It is noticed that $K$ instead of $G$ is used for $\frac{\delta i_a}{\delta e_g}$. Figures 2 (*b*) on page 9 and 39 (*b*) on page 89 require modification as they show the anode currents to be zero for appreciable values of the anode voltage.

In dealing with the antenna-earth system, a few typical circuits used for transferring the antenna voltages to the amplifier grid are analysed. Then follows a discussion of the different circuit arrangements used for high frequency amplification and of the methods adopted to overcome the effect of the anode-grid capacity on stability of working.

The two main types of detection are examined in Chapter V along with their relative performances for normal reception conditions. The treatment of low frequency amplifiers follows the usual lines and includes a description of the advantages of the push-pull arrangement.

In some respects, the chapter on the power stage is perhaps the most useful, as the discussion deals with the triode as an integral part of the whole circuit.

The book is a clear exposition of the essential ground work and is meant to meet the needs of the student of general physics and of the serious amateur.

Limitations of space are obviously responsible for the omission of any treatment of diode detection, heterodyne and superheterodyne reception, high frequency bandpass and low pass filters for sectivity and tone correction, power supply to receivers, and other relevant questions.

The printing and diagrams leave nothing to be added and the text is apparently free from errors. A handy volume well worth its price like the other excellent companion volumes of the series.

R. E.

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ELEMENTARY INDUSTRIAL ELECTRICITY. By L. Raymond Smith. Second edition (1933). Industrial Physics Series.

This little book aims at introducing the students of electrical and allied trades to the elementary principles of electrical circuits, measurements and simple machinery, and fulfils this purpose very satisfactorily. It should also be useful to many others who have to handle simple electrical circuits and machinery in the course of their work. No previous knowledge of electricity is assumed and an attempt has been made to explain everything in non-technical language from first principles so that it should not be difficult for anybody familiar with elementary physics to go through the book without the help of a teacher. The practical aspect of the subject is kept well in mind and most of the principles have been illustrated by a number of very good practical examples. It contains simple but very clear diagrams and an attempt has been made to deal with every subject on a quantitative basis as far as possible. The additional chapter on alternating currents explains the first principles in a lucid manner. Few books of its kind are available and the revised edition should therefore be very welcome to those for whom it is intended.

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AN ELEMENTARY TEXT-BOOK OF SOUND FOR B.SC. PASS STUDENTS. By R. N. Ghose, D.SC., A.INST.P.

The number of books on scientific topics written by Indians is now on the increase. The present volume is conceived on an ambitious scale and is fairly exhaustive. The explanation of physical phenomena is generally detailed and in some cases too much so. The problems dealt with in their mathematical aspects are well chosen. The inclusion of a large number of topics of present-day interest such as the talkie film, the loud speaker, the piezo-electric oscillator, the gramophone, the hydrophone, sound ranging, etc., besides the chapter on the acoustics of buildings enhances the value of the book.

The get-up of the book is very good, and the publishers, Nand Kishore & Bros. of Benares, are to be congratulated for their excellent work.

The arrangement of the subject-matter leaves room for improvement.

There are, however, a few inaccuracies and in several places marked lapses in language, *e.g.*, on p. 3, line 10 and p. 6, line 22, the definitions of wave length are incorrect; on p. 18, line 6, the statement "Then $-\pi$" is obviously wrong; on p. 19, line 20, "$\frac{1}{r}$, where $r$ is an integer" should be "$m/n$, where $m$ and $n$ are integers"; on p. 30, lines 26-27, "fig. 18" is a misprint for "fig. 17" and the reference "*octave*" is no doubt the *second harmonic*. Similarly, on p. 37, line 8, "$y \propto e^i$, and $\frac{d^2y}{dx^2} = -\frac{2}{v^2}y$" and on p. 47, lines 32-34, the jumble of words "two elements....extension $e$ is" are probably evidences of careless proof-reading. There are many more such inaccuracies and lapses which mar the usefulness of the book.

On the other hand, the following errors of expression among a fairly large number, could have been avoided with a little care,

*e.g.*, p. 7, line 6, "listen the sound"; p. 7, lines 8-9, "the angle .... remains" for "angles .... are"; p. 9, line 5, "is greatly interfered by the direction"; p. 18, line 14, "composing" for "composition" and line 31, "minima" for "minimum"; p. 23, lines 33-35, "one particle" .... "both the ends" .... "pegs at 1 cm. apart"; p. 29, line 29, "density of air per c.c."; etc., etc.

The frequent omission of the articles "a" or "the" and their occasional insertion in wrong places strikes even a casual reader.

It is to be hoped that these several defects will be eliminated in a second edition of the book. A. V. T.

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HYDROGEN-ION CONCENTRATION AND ITS PRACTICAL APPLICATIONS. By Frank L. La Motte, William R. Kenny and Allen B. Reed. Pp. 262. (Bailliere Tindall and Cox, London. 1932. Price 20*s*.)

This book which is the outcome of the labours of three technical chemists whose names are not unfamiliar to those interested in the subject of Hydrogen-ion concentration, forms a useful addition to the large number of books now extant. Its special appeal is to the operating chemist who has discovered in Hydrogen-ion control a new and useful instrument, finding intensive application in diverse technological processes. The book thus deals exclusively with the application of hydrogen-ion in industry, a preliminary discourse covering about 55 pages being included with a view to give a somewhat elementary treatment of the theoretical aspects of the subject which will be found useful to those whose early scientific training has not included this phase of chemistry.

The simple principles involved in pH measurement find adequate explanation in non-technical language which can be understood even by a lay chemist. The potentiometric method is excluded from the treatment. The inclusion of the glass electrode whose discovery has made possible an accurate determination of the Hydrogen-ion concentration of unbuffered solutions, and oxidising and reducing media, and the quinhydrone electrode method (or its several modifications such as the hydro-quinhydrone method) which yields good results in the hands of even beginners, would have greatly added to the value of the book.

One of the special features of this publication is the inclusion of charts, which indicate at a glance the important pH zones requiring attention in the various industries which have been surveyed in the volume, and these would prove of great assistance to the practical chemist. Selected references are added at the end of each chapter. Most of them refer to publications of 1927 or earlier years. One would have wished for a more up-to-date and comprehensive list of references. Some space could have been usefully devoted to the rubber industry, in which standardisation of conditions for manufacture of various goods for latex calls for pH control.

On the whole, the book is a useful addition to the library of every chemist to whom it will prove to be, as the authors have claimed, "a useful guide capable of assisting routine problems".

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MASS-SPECTRA AND ISOTOPES. By Dr. F. W. Aston, SC.D., F.R.S., Nobel Laureate. Pp. xii+248 (Edwin Arnold & Co., London. 1933. Price 15*s*. net.)

This new book by Dr. Aston is a natural sequel to his well-known book "Isotopes", a second edition of which appeared nine years ago. This extraordinarily valuable book is divided in a very happy manner into four parts which deal with the subject-matter from the following aspects: (1) Historical; (2) Production and analysis of mass-spectra; (3) The elements and their isotopes; and (4) Theoretical and general.

The subject-matter of Part I (54 pp.) is substantially the same as that presented in "Isotopes", the obvious reason for this being that even to-day it serves as an eminently suitable historical introduction to the subject of mass-spectra. Part II deals with the experimental methods employed for the production and measurement of mass-spectra. It is well-nigh impossible to speak too highly of the merits of this portion of the book presenting as it does with characteristic detail an account of experimental work of the most refined type. The unforeseen difficulties which had to be overcome before the second mass-spectrograph could be put into successful operation are described in an impressive manner; thus, in p. 77 for instance, "After months of disappointing work it was found that the cause was a polarization of the surfaces of the plates which might take as long as 0·05 second to reach its maximum value. Drastic scrubbing with emery paper reduced the effect temporarily and also the curvature of

the lines which is due to the same cause, and the plates were later heavily gilded. With a clean gilded surface the effect was reduced to manageable proportions. Arrangements were now made to measure it with the highest accuracy possible."

In Part III Dr. Aston presents in outline the evidence on which the isotopic constitution of each individual element was established and their bearing on important questions in clear "Chemistry". The last part of the book, *viz.*, Part IV, is mainly of theoretical and general interest. Statistics concerning the relative abundance of isotopes of the odd and the even (at no.) elements and the relative abundance of the different atomic species in the earth are shown in very elegant charts on pages 179–81 and 184–85. Two chapters are devoted to an exposition of the isotope effect in molecular and atomic spectra and a résumé of important work relating to those problems. The principles underlying the separation of isotopes are indicated in the last chapter along with a short account of the researches in which such separation was actually achieved, including that of the hydrogen isotope ($H^2$) obtained by Lewis only a few months ago.

Appendix I, II, and III respectively contain data relating to (1) packing fractions and isotopic weights, (2) isotopes and their percentage abundance, and (3) the periodic table of elements. The first two are thoroughly up-to-date, but it is a pity that the third, *viz.*, the periodic table, shows gaps for elements of atomic numbers 43, and 61, namely, masurium and illinium.

The book under review is one of the most readable scientific books in the English language and it can be heartily recommended for study not only to all physicists and chemists but to workers in other branches of science as well. K. R. K.

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THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE. By E. C. STUART BAKER, C.I.E., O.B.E., F.Z.S., etc., Volume II. *Turdidæ* and *Sturnidæ*. With six plates. Pp. vi+536. (Taylor and Francis, Red Lion Court, Fleet Street, London, 31st May 1933. Price 30*s.*)

We have pleasure in according a hearty welcome to this classic memoir. The author is a leading authority on Indian ornithology and his series of contributions published in the *Journal of Bombay Natural History Society* and his volumes in the "Fauna of India" series are well known. The present volume dealing with twelve families of the order Passeres is a remarkably interesting contribution, supplementing our knowledge of the general and breeding habits of these groups hitherto derived from Oates' publication of Hume's "Nests and Eggs of Indian Birds". The great merit of the work is that in several particulars where our information was either inaccurate or defective, our knowledge of the nidification of Indian birds has been brought up-to-date by supplementing, confirming or correcting the recorded observations of the older authors. The two volumes of Mr. Stuart Baker will be an invaluable addition not only to the reference libraries of colleges where Zoology is taught, but to all public libraries where the general readers might wish to obtain information on the occurrence, distribution and habits of birds, both resident and migratory ones, which force themselves on his observation.

Nature study, however fundamental, is a neglected field in the education of the Indian child and no country is better fitted for encouraging school boys and girls to cultivate habits of observation, collection and classification of animals and plants in their immediate vicinity and it is not an uncommon thing to come across men of wide culture who know all about the universe except the little animals and plants under their very eyes. The Indian mind is generally introspective and has been rendered absolutely metaphysical by the education which lacks objectivity and realism and is totally unconnected with human surroundings. We can hardly think of any single group, of animals better calculated to attract, interest and profit the human mind than birds whose form, flight, colour, songs and voices, courtship, nets, brooding habits, eggs, nestlings and parental care, jealousies, co-operation, enemies, educability and native instincts, adaptive modifications, migration, food, rôle in the economy of nature, æsthetic sense and standard of taste and economic importance will each provide a basis for life-long study and the only equipment for it being an enquiring mind and pair of observant eyes.

The book is packed with delightful information and most of the birds dealt with are common residents of plains and hills. The main difficulty of the Indian is that he does not know how to recognise the common birds, except perhaps the crow, the sparrow

and kites and as regards the first, the grey-necked crow and the black-necked one are confused to be the female and male of the same species. Bird study should be encouraged in all rural schools and early recognition by the school children of the important part these feathered animals play in keeping the insect pests and other vermin under control and their own destructive tendencies will be invaluable in planning future campaign for their protection of the useful and elimination of the harmful ones. But the main interest must centre in the study of their habits and Stuart Baker's book provides it. We cannot emphasize the usefulness of the two volumes on the nidification of birds of the Indian Empire more than by saying that they should be found in the libraries of all educational and public institutions, clubs, and learned societies. Perhaps the inclusion of pictures of all the birds will greatly enhance the value of these volumes and if the cost is not prohibitive, we would recommend their inclusion in the future editions.

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PSYCHOLOGICAL FOUNDATIONS: A Contribution to Everyman's Knowledge of Himself. By Theodore J. Faithfull. Pp. xv+242. (John Bale, Sons, and Danielsson, Ltd., London, 1933. Price 10*s*. 6*d*. net.)

Theodore Faithfull belongs to the Freudian School and is a keen exponent of the theory of the unconscious mind and the technique of psychoanalysis. The book attempts to trace the stages of human development and the channels of perception and expression and the author hopes that it will help the study and appreciation of that Universal consciousness of life which alone can save "the human race from experiencing disaster in the coming age of plenty". Not only in education, but in criminology, psychiatry and social science, the solution of human problems depends upon a wide appreciation of and intimate acquaintance with psychology and the followers of Freud claim that this is essentially a study of duality in personal unity with all its anchorings, overstimulations, transferences, inversions and reversions.

The evolution of mind and consciousness of sexuality as manifested in man on the intellectual and intuitional levels is traced from the simplest unicellular organisms and the chapters on the sensational and emotional and intuitional function are a contribution to Freudian exegesis. The psychoanalyst is an extraordinarily skilful interpreter of seemingly harmless things in waking and dream states in terms of sex and repressed wish. Organs like the eye, ear and nose; objects like the toothbrush, soap-box and doll; things like a tree in the landscape, marshy ground and soft wood; experiences like floating, ascending a staircase or running; and everything else has a profound sex significance in Freudian psychology. Mental affections like fear, pain, pleasure; physical states like cramping and pressure are conceived as Libido discharge. Classic myths which amused and enlightened human minds which derived invaluable moral lessons, are interpreted as neat illustrations of Freudianism. Hymen's smoking torch at the wedding of Orpheus, the flame at the altar of the festival of Venus, the winged Pagasus and Centaur Nessus have lost the poetical fancies which our early education had developed in us, but have acquired a new sex significance. Children's drawings and composition in story writing have not escaped from the interpretations of psychoanalysts. The parables and miracles of Jesus are regarded as part of the teachings of Freudian philosophy. According to its tenets, man and woman, whether they be friends, or be related by family ties in the form of father and daughter, or brother and sister, cannot meet or talk with each other without sex consciousness, and anything that either of them may see or experience in the dream state subsequently must have reference to the unconscious Id, Libido wish or intraversion and extraversion. Poor old women and fat men in dreams have their tale to tell.

Whatever one's attitude may be towards the extravagances of this new psychology and its technique, the book under review is a clear and logical presentation of all the facts of Freudianism in a simple and easily understood language. It forms an excellent introduction to the study of the bewildering psychology of the unconscious mind and provides the means for understanding in its technical terms one's own obscure and apparently inexplicable states of the waking mind and dream experiences. To a beginner commencing Freud, Faithfull's book is an invaluable guide.

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